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Arduino Based Covid Disinfection Box

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ABSTRACT

The work titled "Arduino Based Covid Disinfection box" aims to build a disinfection box which will sterilize various day-to-day objects like masks and keys. Outbreaks of the virus are highly contagious and life-threatening. One of the necessary steps in the fight against the outbreak of the epidemic and victory over the global pandemic is the disinfection of infected surfaces. Keeping public places safe and clean can be quite challenging, especially if other people are in frequent contact with each other. Common areas and high-contact surfaces are manually disinfected using the hand-held disinfectant. Manual disinfection exposes a cleaner to a contaminated surface by increasing the risk of infection. The use of disinfection box reduces the risk of infection, and overcomes the costs associated with manual cleaning agents. Excessive use of the disinfectant can cause serious health problems. This pandemic forced us to develop and build secure disinfection equipment for UVC disinfection for public spaces. UVC Rays can easily be skipped during manual cleaning and are not harmful to human skin and eyes. The disinfection box provides an effective and efficient solution for disinfecting high-risk and contact surfaces without human intervention.

Keywords : Arduino uno, Covid, C, disinfection, IDE

I. INTRODUCTION

Coronavirus disease (COVID19) is caused by SARSCOV2 and is the causative agent of the fatal disease of major public health problem worldwide. Extensive measures to reduce the person-to-person transmission of COVID-19 have been implemented to control the current outbreak. Early detection of current coronavirus often consists of checking a person's body temperature. Body temperature is one of the vital signs indicating a person's health status. When a person's body temperature is higher than normal, it is said to have a fever. Fever can be caused by abnormalities in the brain itself or by toxic substances that affect the body's thermoregulatory centres. As the name tells, ultrasonic sensors measure distance by using ultrasonic waves.

The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the object by measuring the time between the emission and reception. An optical sensor has a transmitter and receiver, whereas an ultrasonic sensor uses a single

ultrasonic element for both emission and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturization of the sensor head. UV-C (100 – 280 nm or 200 – 280 nm), also known as deep UV, UVC or germicidal UV, which has applications in sterilization and sensing. The most important benefit of UV light disinfection is that it's not toxic. Unlike chemicals that are sometimes used in cleaning and sanitization products, UV light is environment friendly. UV light disinfection is a physical process, not a chemical one. Since UV disinfection is a dry method, we can be absolutely sure that it will take care of existing mold and will prevent its growth in the near future. The use of some traditional antimicrobial agents and disinfectants has had dire consequences. The development of antibiotic-resistant bacteria is a significant problem in the medical community.

Unlike traditional disinfection methods, UV light disinfection is a physical method for killing bacteria. Therefore, bacteria in question cannot build immunity to it. That's a huge plus, particularly for hospitals and assisted living facilities. It might surprise you to know that UVC disinfection is an affordable sanitization method. People sometimes assume that it's costly because it uses technology instead of chemicals, but that's not the case.

A one-time investment in UVC light disinfection technology can save you time and money for years because the unique property of our lens means you will not have maintenance costs over the life of the product and since the unit can operate autonomously when installed you don't have the associated labor costs over time like other methods do. UltraViolet-C (UV-C) lamps may be used to supplement current hospital cleaning and disinfection of surfaces contaminated by SARS-CoV-2. Our aim is to provide some practical indications for the correct use of UV-C lamps. Any facility that needs to disinfect air spaces can use a UV light to do so, to some extent. There needs to be sufficient contact of the air with the UV light, making this type of disinfection more effective on still or stagnant air than on moving air. To improve the efficacy of air disinfection, many facilities choose to install UV disinfection lights at the upper level of the room, so as the air naturally circulates, it will be cleaner.

Facilities can also choose to install UV lamps near coils and drain pans of cooling systems such as air conditioners and refrigeration devices, which can prevent bacteria from growing in those cool, damp conditions and eventually being released into the air.Facilities can also use UV light to disinfect water and even for wastewater treatment. Because UV disinfection is a physical process and does not require adding any chemicals to the water to clean it, this can be a very safe and effective option. UV light can reduce the incidence of parasites such as cryptosporidia or giardia, which can be resistant even to chemical disinfection. While wastewater treatment must take place on a much larger scale, UV light can play a major role in this process as well, even taking the place of chlorination. While UV light is not used as a sole disinfection protocol, it has become quite common in many metropolitan areas as part of the wastewater treatment process.

II. LITERATURE SURVEY

Milad Raeiszadeh et al. [1] "A Critical Review on Ultraviolet Disinfection Systems against COVID19 Outbreak: Applicability, Validation, and Safety Considerations" 2020 In this paper they have overcome the disadvantage of UV light to disinfect objects by using UVC light instead of the normal UV light. Since UV light is harmful for human skin and eyes while UVC light is not harmful to human body.

G Katara et al. [2] in their paper named "SURFACE DISINFECTION BY EXPOSURE TO GERMICIDAL UVLIGHT", discuss about the data sensed by the PIR sensors is processed by the microcontroller and a message is sent to, the robot.

Irene Maria Anto et al. [3] in their paper named "Arduino-based Automated Washroom Sanitizing System" discussed about the autoflush device uses an Arduino Uno that acts as an interface to control the components and acts as an output and input detector.

Marcel Bentancor et al. [4] in their paper named "Programmable and low-cost ultraviolet room disinfection Device" the UV disinfectant device uses remotely programmed using an Android mobile device and it has an infrared detection security system that switches off the system when initiated.

Leo Louis et al. [5] in their paper named "Working principle of Arduino and using it as a tool for study and research" discussed about in details the potential of Arduino and it can be used as a means for study and research.

Albert J. Fornace et al [6] in their project named "UV decontamination of personal protective equipment with idle laboratory biosafety cabinets during the COVID-19 pandemic" the author has discussed about the measured UV fluence using a UV meter and measured variance due to mask geometry using an array of three photodiodes.

Shih-Ping Huang et al [7] in their paper named "Ultra-Wideband Positioning Sensor with Application to an Autonomous Ultraviolet-C Disinfection Vehicle". In this paper the authors have designed vehicle with Ultraviolet-C lamp which is designed and implemented using an ultra-wideband positioning sensor.

Avinash. R et al [8] in their paper named "UV-C Disinfecting and Health Checkup System for Coronavirus", the author uses Arduino as Controller, LED's and has ability to detect and disinfect items present inside the box using UV radiation.

Jia Hu et al [9] in their paper named "Automated Device for Public Elevator Control Panel UVC Sanitization" the author has discussed the sensing and control system was tested in an elevator and it was demonstrated to be able to detect operating conditions and

activate the UVC light at appropriate instances.

Samuel K. Moore et al [10] in their paper named "Ultraviolet-LED Maker Demonstrates 30-Second Coronavirus Kill" the author has discussed that UV LEDs are deadly to viruses and bacteria.

Dana Mackenzie et al. [11] in their paper named "Ultraviolet Light Fights New Virus" the author has discussed that UV light is surging in popularity as a method for disinfecting hospital rooms and other public spaces.

Sharnil Pandya et al [12] in their paper named "Smart epidemic tunnel: IoT-based sensor-fusion assistive technology for COVID-19 disinfection" the author has discussed that an automatic sanitizer spray system equipped with a sanitizer sensing unit disinfects.

Goda Vasantharao et al [13] in their paper named "Temperature Detection and Automatic Sanitization and Disinfection Tunnel-COVID 19" the authors have discussed that construction of a sanitization and disinfection tunnel considering the COVID19 pandemic situation.

Asif Ahmed et al [14] in their paper named "Design of a contactless body temperature measurement system using Arduino" the authors have discussed the real time monitoring of body temperature using embedded platform has been presented.

Nenad Petrovic et al [15] in their paper named "IoT-based System for COVID-19 Indoor Safety Monitoring" the authors have introduced an affordable IoT-based solution aiming to increase COVID-19 indoor safety, covering several relevant aspects: 1) contactless temperature sensing 2) mask detection 3) social distancing check.

A. Vyshnavi1 et al [16] in their paper named "UV Disinfection Robot with Automatic Switching on Human Detection" the authors have discussed about

data sensed by the PIR sensors is processed by the microcontroller and a message is sent to the robot.

Beatrice Casini et al [17] in their paper named "Evaluation of an Ultraviolet C (UVC) Light-Emitting Device for Disinfection" the authors have discussed about implementation of environmental cleaning and disinfection has been shown to reduce the incidences of healthcare-associated infections.

George Byrns et al [18] in their paper named "The Uses and Limitations of a Hand-held Germicidal Ultraviolet Wand for Surface Disinfection" authors have investigated whether a hand-held germicidal wand can efficaciously disinfect surfaces treated with either a vegetative or spore forming bacterium.

Taylor et al [19] in the paper named "UV Air Cleaners and Upper-Room Air Ultraviolet Germicidal Irradiation for Controlling Airborne Bacterial and Fungal Spores" it is studied six different types of ACs and quantified their ability to remove and/or inactivate airborne bacterial and fungal spores.

N. Rudnick et al [20] in their paper named "Fundamental Factors Affecting Upper-Room Ultraviolet Germicidal Irradiation", the authors have tested in this study is that the efficacy of upper-room UVGI to inactivate or kill airborne infectious microorganisms can be determined from an index of UVGI effectiveness.

III. PROPOSED SYSTEM

A. Methodology

• Program is uploaded in the Arduino Uno board.

• The circuit is given the necessary supply and the program starts to execute.

• Firstly, LCD will show "Welcome" message and then it shows "Put the object in the box".

• When the user puts the object that is needed to be disinfected, in the box the ultrasonic sensor will calculate the area of the object and send it back to the Arduino. In the Arduino the formula for calculating the time required for the disinfection is already uploaded inside the code.

• Now the locking mechanism of the box takes places through the servo motor which restricts the opening of the box during the disinfection process

• The UVC light is connected to the AC mains. The formula in code will find the time required, and accordingly the relay will switch ON the UVC light and the LCD will show "wait for x seconds" where x is the time required for disinfection.

• After the completion of disinfection, the relay will switch OFF the UVC light and the unlocking mechanism of the box will be done through servo motor. Once the box is unlocked the LCD will display "Open the box".

• This shows the completion of the disinfection

• When the user will open the box and remove the object and close the box, the LCD will show "Welcome" once again

B. Flow Chart

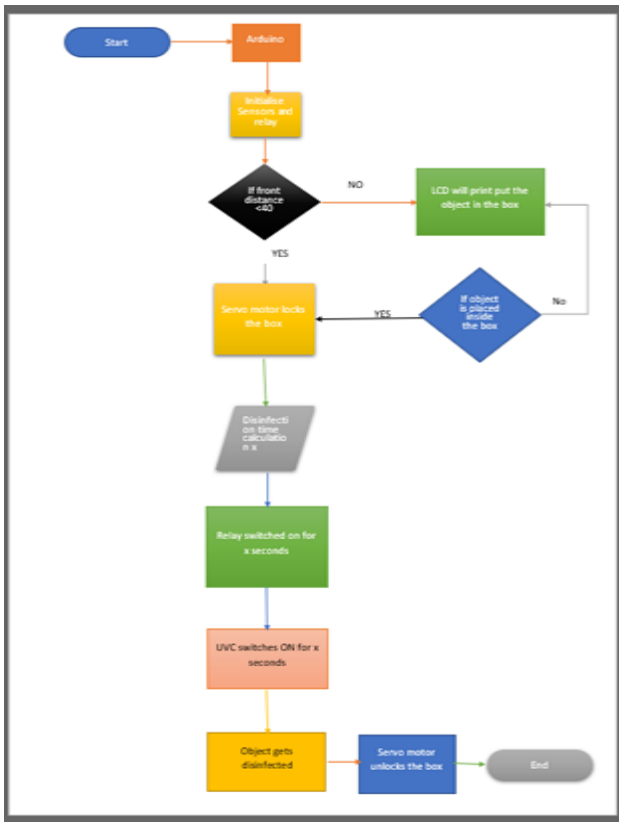

Figure 1: Flow Chart

C. **Block Diagram**

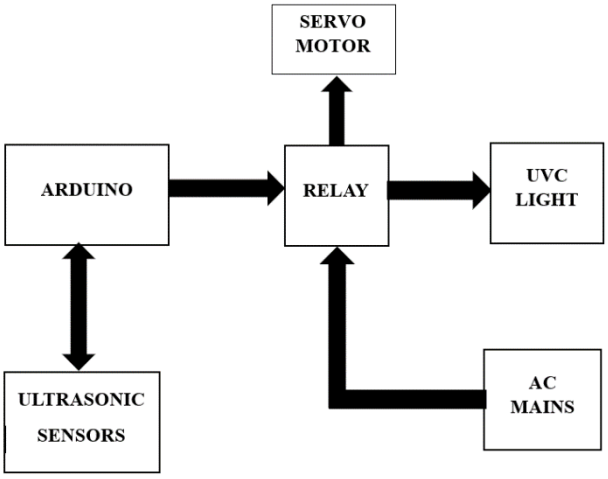

Figure 2: Block Diagram

1) Arduino: Arduino Uno is a microcontroller board based upon the Microchip ATmega328P microcontroller. The board has sets of digital and analogue input/output (I/O)

Figure 3: Arduino Uno

pins that may be interfaced to various boards (shields) and other circuits.

2) Relay: A relay is an electrically operated switch. Relays can control one electrical circuit by turning ON and turning OFF contacts in different circuit.

Figure 4: Relay

They generally use an electromagnet (coil) to operate their internal mechanical switching mechanism.

3) UVC light: UV-C light is germicidal – i.e., it deactivates the DNA of bacteria, virus and other pathogens and thus destroys their ability to multiply and cause disease. Figure 5: UV-C Light

Specifically, UV-C light causes damage to the nucleic acid of microorganisms.

4) LCD: A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In figure 6: LCD this each character is displayed in 5x7 pixel matrix.

5) Servo motor: A servo motor is an electromechanical device that produces torque and velocity based on the supplied current and voltage. A servo motor works as part

Figure 7: Servo Motor

of a closed loop system providing torque and velocity as commanded from a servo controller utilizing a feedback device to close the loop.

D. **Circuit Diagram**

Program is uploaded in the Arduino Uno board. The circuit is given the necessary supply and the program starts to execute. Firstly, LCD will show "Welcome" message and then it shows "Put the object in the box". When the user puts the object that is needed to be disinfected, in the box the ultrasonic sensor will calculate the area of the object and send it back to the Arduino. In the Arduino the formula for calculating the time required for the disinfection is already uploaded inside the code. Now the locking mechanism of the box takes places through the servo motor which restricts the opening of the box during the disinfection process. The UVC light is connected to the AC mains. The formula in code will find the time required, and accordingly the relay will switch ON the UVC light and the LCD will show "wait for x seconds" where x is the time required for disinfection. After the completion of disinfection, the relay will switch OFF the UVC light and the unlocking mechanism of the box will be done through servo motor. We have used the standard formula for dosage time calculation using intensity of the UVC light and surface area of the object. The formula calculates the time required for a particular object to be disinfected according to the area of the object and the necessary light intensity. Once the box is unlocked the LCD will display "Open the box". This shows the completion of the disinfection. When the user will open the box and remove the object and close the box, the LCD will show "Welcome" once again.

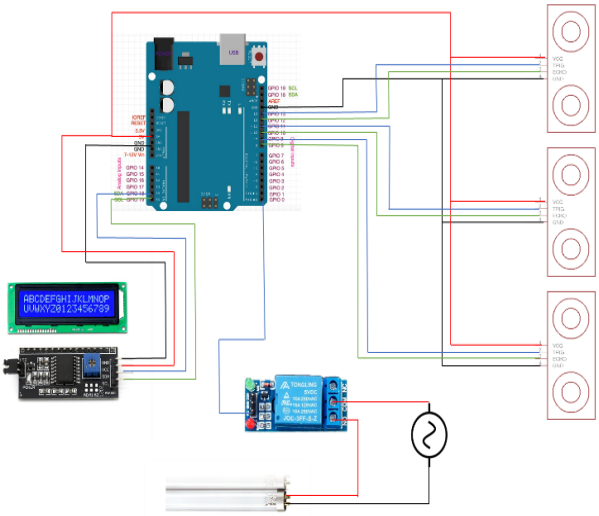

Figure 8: Circuit Diagram

IV. **RESULTS**

A. **Simulation Results**

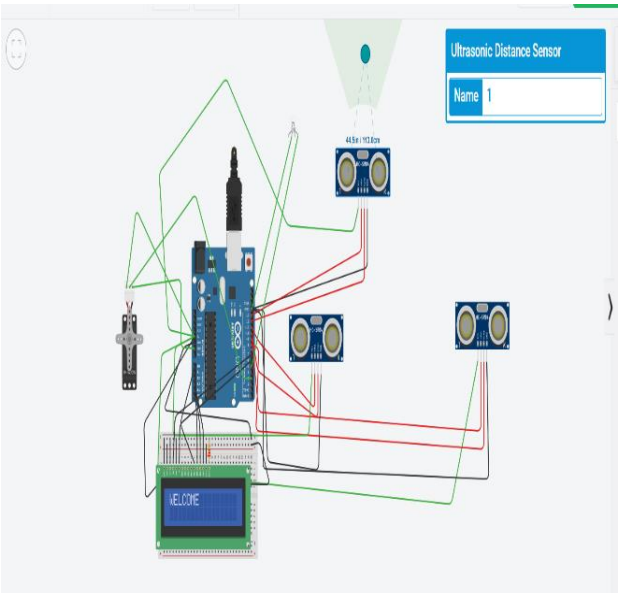

Figure 9: Simulation 1

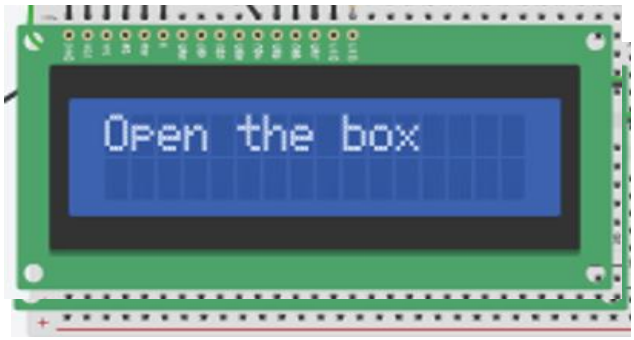

Figure 10: Simulation result 2

Figure 11: Simulation 3

Figure 12: Simulation 4

B. **Tabulated Results**

Sr No	Display	Process
1	Welcome	Box Initiation
2	Put the Object in the box	Waiting for the user to Keep the object in the box
3	Please wait for 'x' seconds	Disinfection in progress for 'x' seconds
4	Open the box	Disinfection complete, waiting for the user to remove the object.

Table 1: Function and Process

The above table shows us the various processes occurring and their corresponding display messages. The 'x' denotes the particular time required for the object to be disinfected, which is calculated by the formula.

C. **Hardware Implementation**

Figure 13: Frontend Snapshot

Figure 14: Backend Snapshot

V. FUTURE SCOPE

There are UV disinfecting boxes in the market, but one of the important features that they all were missing was, the 360-degree all-round disinfection. This model eliminates this limitation and disinfects all the surfaces of the items automatically giving a complete disinfection without harming the human skin unlike the UV light this project uses UVC light which because of its special wavelength sanitizes the whole object. The future need for this model will be high as it is cost effective and has no disadvantages. In this project size of the box may be made variable according to the need of the user. A Fingerprint lock can be added to this project to enhance the security. In the future the box can be made for completely and safely disinfecting food items by adding or making appropriate changes. It has proven to deactivate all existing Corona Viruses variants. It has an automatic timer-based display which shows what the user should do. It will be able to sterilize food along with the mask and other day to day things. It has a variable disinfection timer setting which will calculate the time required for disinfection of a particular object. It has a servo motor which locks the box while the disinfection process ensuring safety. The box will gain importance as it is easy to use and has no harmful chemicals in it.

VI. CONCLUSION

The exposure of the softwares like Arduino IDE and Tinkercad led us to making the box right from the basic including the coding part. This project used UVC light which has special wavelength that penetrates the object for maximum disinfection. The working of every component is thoroughly dealt with. We have successfully simulated “Arduino based Covid disinfection box” by using UV-C light and number of ultrasonic sensors to measure the distance so that how much disinfection is going to be needed can be calculated. The bigger the object the faster the UV light will reach the object’s surface therefore less time is required for disinfection and in case of smaller objects the light takes more time to reach the object’s surface as the object will at a greater distance. We have used the standard formula for dosage time calculation using intensity of the UVC light and surface area of the object. For additional security we have implemented the servo motor for locking mechanism, which when

unlocks the lights turn OFF and it is safe to remove the object from the box. The servo motor is connected to the relay, which ensures the accurate timing for the box to be locked or unlocked which in turn provides security for the user. The UV-C lights which are placed on the sides of the wall completely disinfect the object according the formula. The lights will only turn ON when the servo motor locks the box and the lights will turn OFF when the servo motor unlocks the box. When the object is placed in the box the LCD will show the message “please wait for x seconds” where x denotes the time calculated. When the box is unlocked after disinfection the box will again show “welcome” message.

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