DISINFECTION BOX USING UV-C RADIATION

Aniket Kavathekar[1], Chinmay Palkar[2], Sandip Shedbale[3],

Akash Shinde[4], Prof. A. G. Koparde[5]

[1,2,3,4] *Student, Department Of Mechanical Engineering, ATS SBGI MIRAJ, pan INDIA)*

[5] *Professor, Department Of Mechanical Engineering, ATS SBGI MIRAJ, pan INDIA)*

Abstract

Ultra Violet radiation, Chlorination, washing with soap and heating are some methods of sterilizing. Ultra Violet light is the best sterilizing and disinfectant agent, used for domestic as well as clinical purpose. Food packets, books, stationery, medical equipments, toys, electronic gadgets 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 and is eco-friendly, if used in a controlled manner. UV radiation is a range of electromagnetic waves with shorter wavelength (high frequency and energy). The wavelength from 100-280 nm known as UV-C is the best disinfectant used for purifying water, air, sterilizing vegetables and surgical equipments. Research has shown that UV-C wavelength can kill harmful fungi, protozoa, bacteria and viruses like SARS-CoV-2 Virus. The article describes the construction of a low cost UV-C Sterilizer Box where UV radiation is taking place in a closed environment. Safety features are also incorporated to prevent humans from UV light exposure.[1]

Keywords: *Disinfection, Sterilizer, UV, UV-C, Virus.*

I. INTRODUCTION

Covid19 changed all of humankind in 2020. Due to its fast and efficiently spreading nature, we were forced to use face 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 cant sanitize files, paperwork that doctors exchange with patients or employees exchange with each other.Well we solve this huge problem, we design a 360 degree disinfection box using ultraviolet sterilization to solve the issue. The system makes use of 2-3 uv c tubes to achieve this task. Ultraviolet light is a form of electromagnetic radiation of a light with more energy than visible light, but less energy than x-rays. It can be classified into UV-A (315-400nm), UV-B (280-315nm) and UV-C (100-280nm). The higher energy UV rays can damage DNA and RNA via cross linking of thymidine and Uracil nucleotides, respectively. The damage caused to DNA and RNA can result in destroying of replication of this organisms as it removes them from core. Now UV C has been proven to kill all viruses within a matter of seconds. [2]

II.   OBJECTIVE

The main objective of this project is to sanitize the items you use in your daily life which you cannot sanitize with liquid sanitizer so there is a possibility of spoilage of those items which cannot be sanitized. The main objective of this project is to sanitize items such as mobiles, files, documents, money, etc., which can be damaged by liquid sanitizer.[2]

III.   SCOPE OF PROJECT

In human daily life, a person comes in contact with many Germs and there can be Germs on every object. But this project is made because some things cannot be sanitized. We can use this project as medical equipment. We can also use this project in other places like hospitals, colleges, offices and even at home. Its use will save human beings from getting infected with germs as we can use this project to eradicate the germs. This project will be very useful in the future as we can also disinfect the vegetables in the market. This will benefit every human being. The project targets public places such as airports, railway stations, Hospitals, Schools, Colleges, Corporates and malls where average footfall is greater to maintain the social distancing norms. Physical implementation of this project at least one of the above places will ensure complete destruction of COVID-19 virus.[2]

IV.   BLOCK DIAGRAM

The Arduino controller takes user input for time setting and starts sterilization when start button is pressed. It automatically shuts off when the sterilization time is completed. Also an automatic shutoff system shuts off the sterilization if lid is opened by user between ongoing sterilization.
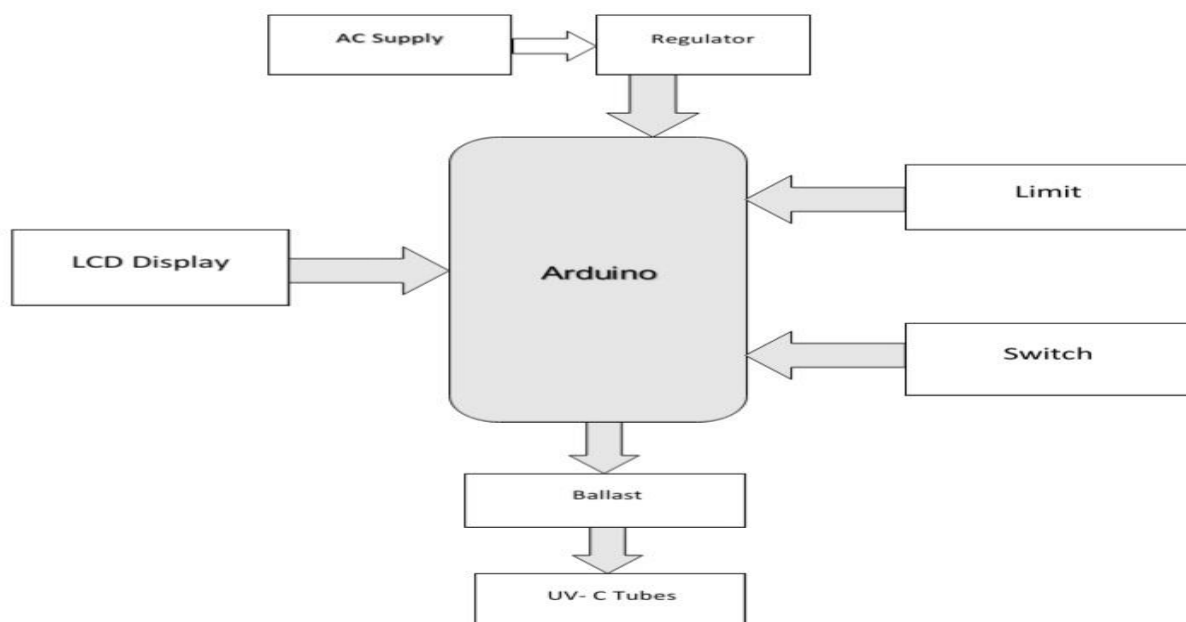

Fig.1 Block Diagram of Disinfection Box

Fig.2 Arduino Uno

V. COMPONENTS

- Arduino Uno
- LCD Display
- Buzzer
- Limit Switch
- UV-C Tubes
- On/Off Switch
- Metal Mesh
- LED's
- IC's
- Resistors
- Capacitors
- Diodes
- Transistors
- Screws and Bolts
- Push Buttons
- Fan

VI. METHODOLOGY

The disinfection box is made up of mild steel(powder coated) of dimension 585mm x 302mm x 286mm. Two 15Watts UV-C tubes are placed at two sides of the box. Inner walls is laminated with Aluminum foil for better reflection, and a steel mesh is placed at the bottom with elevation of 30mm to get maximum UV exposure to the object kept for sterilization. The limit switch is placed on the front side wall of box, so that the switch will be operated while opening the lid.

- Step-1: After procurement of raw material, marking, cutting and bending of the sheets as per the drawing.
- Step -2: Welding of the extra brackets.
- Step –3: Powder quoting of the individual parts.
- Step -4: Assembling of the Box.
- Step-5: After assembling, fixing of the PCB into the box. Mounting all the components like LED indicators, UV bulbs with fixtures buzzer, sensors, countdown counters, etc.
- Step-6: Laying and connecting the wires to the components.
- Step-7: Testing the equipment as per the pre-determined standards.

VII.   UV LIGHT

UV or ultraviolet light is a type of radiation. In simple terms, when bacteria or another type of microbe is directly exposed to certain types of UV light, the DNA (its fundamental building block) of the cell is damaged, preventing it from replicating. If a cell cannot reproduce, then the cell cannot cause infection, which is how UV light kills bacteria. The UV process is a physical process as opposed to the addition of chlorine to the water to address microbiological issues which is a chemical process. This is important, because it allows UV to kill bacteria and other microorganisms without adding anything to the water or creating what is known as disinfection by-products (like trihalomethanes, called THMs for short, which are proven to be carcinogenic).[2]

VIII.   FIGURES & TABLES

Fig.3 Disinfection Box using UV-C Radiation

> ### Formula to find out dosage of UV-C light:

UV Dose = UV Intensity ($\mu W/cm^2$) x Exposure Time (seconds).[3]

Table no.1: Summary of UV Doses Needed to Deactivate Coronaviruses

Microbe	D90 dose (exposure) required	Source
Coronavirus	7 J/m2	Walker 2007
Berne virus (Coronaviridae)	7 J/m2	Weiss 1986
Murine Coronavirus (MHV)	15 J/m2	Hirano 1978
Canine Coronavirus (CCV)	29 J/m2	Saknimit 1988
Murine Coronavirus (MHV)	29 J/m2	Saknimit 1988
SARS Coronavirus CoV-P9	40 J/m2	Duan 2003
Murine Coronavirus (MHV)	103 J/m2	Liu 2003
SARS Coronavirus (Hanoi)	134 J/m2	Kariwa 2004
SARS Coronavirus (Urbani)	241 J/m2	Darnell 2004

IX. CONCLUSION

The article describes about the construction and working principle of Disinfection Box using UV-C radiation which is controlled by a microcontroller ATmega328P. It also describes how to interface the microcontroller with minimum peripherals required to build an affordable, Do-it-yourself project and programming of ATMEL microcontroller ATmega328P. This project describes features like count-down timer, user safety features, easy to built and low cost than that of existing UVC Sterilizers available in market.

X. ACKNOWLEDGEMENT

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