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Abstract— **UV Lights and Lamps: Ultraviolet-C Radiation, Disinfection, and Coronavirus Given the current outbreak of Coronavirus Disease 2019 (COVID-19) disease caused by the novel coronavirus SARS-CoV-2, consumers may be interested in purchasing ultraviolet-C (UVC) lamps to disinfect surfaces in the home or similar spaces. The FDA is providing answers to consumers' questions about the use of these lamps for disinfection during the COVID-19 pandemic**

I . ***Keywords***— UV, corona, sanitization, microtunnel, disinfectant

I. Introduction

As we know that Corona virus is spreading all over the world and the number of deaths are increasing day by day.It has been declared as a pandemic by the World Health Organisation (WHO) as this is a deadly virus which can infect any person coming in contact with the virus and also to the person who comes in contact with an infected person. After few days of research scientists said that to reduce the spread of this virus one must take precautions - which are wearing a mask, gloves, and sanitizing your hands regularly with hand sanitizers which contains at least 70 percent alcohol in it.After sometime scientists discovered that this virus can stay active on the objects be it metal, wood, wall or any kind of surface for enough period of time to infect other person. So it becomes necessary to not only sanitize your hands or body but also to sanitize the objects. But it is not possible to sanitize every object or surface using the liquid sanitizers. This project basically focuses on sanitizing the objects which are used in our day to day life using UV-C light as a disinfectant. UVC light has been used extensively for more than 40 years in disinfecting drinking water, waste water, air, pharmaceutical products, and surfaces against a whole suite of human pathogens. All bacterias and viruses tested till date including the corona virus react to UVC disinfection. Some organisms are more susceptible to the UVC disinfection than others, but all tested so far do respond at appropriate doses. COVID-19 infection can also be caused by coming in contact with infected objects and then touching your facial areas.

Minimizing this risk is the key as this virus can stay on steel and plastic surfaces for upto 3 days. Normal cleaning may leave behind some residue which UVC can treat well.

Scientists have proven that UVC can be used to make the virus inactive and also for disinfecting the objects when exposed for a specific period of time. This project is designed to disinfect the objects using UVC light by placing the object on a 2-way motion conveyor belt. It includes sensors and a microcontroller to automatically on/off the UVC light and the conveyor belt which reduces direct human contact.

II. LITERATURE REVIEW

Refered paper 1 An in vitro experiments by HU researchers showed that 99.7 percent of SARS-COV-2 virual culture was killed after a 30- second exposure to 222nm UVC irradiation at 0.1 mW/cm2. The study is published in the American journal of infection control. Tests were conducted using Ushio'care222TM Krypton chloride excimer lamp. A 100 microliter solution containing the virus(ca. 5*106TCID50/ML) was spread onto a 9-centimeter sterile polystyrene plate. The researches allowed it to dry in a biosaftey cabinet at room temperature before placing the FarUVC lamp 24 centimeter above the surface of plate **Hiroshima University(American journal of infection control)**

Refered paper 2 Severe acute respiratory syndrome (SARS) is a life threatening disease caused by a novel corona virus termed as SARSCOV. Due to extremity of the this disease, the world health organization recommends the manipulation of active viral cultures of SAR-COV be performed in containment laboratories at bio safety level3. The virus was inactivated by Ultra-Violet light (UV) at 254nm ,alkaline(pH¿12) or acidic(pH¡3)conditions and heat treatment of 65 degree celcius or greater Ultraviolet light treatment was performed in 2ml aliquots of virus (volume depth = 1cm) in 24-well plates(corningInc., corning,NY). The UV light source (spectronics corporation, Westburry,NY) was placed above the plate at a distance of 3cm from the bottom of wells containing the virus samples. At 3cm our UVC light source (254nm) emitted 4016 uW/cm2 and UVA light source (365nm) emitted 2133uW/cm2, as measured by radiometric analysis(spectronics corporation). After exposure to the UV light source, virus was frozen for later analysis by TCID50 assay using CPE as the end point SOURCE: **journal of Virological Method**

Refered paper 3 A best way to control airborne viral transmission is to inactivate them in short period of time of their generation. germicidal ultra-violet light typically at 254nm can be used, but it is health hazardous to skin and eyes. Alternately far UVC light (207- 222nm) efficiently kills, virus and bacteria by breaking chemical bonds in RNA and DNA which are

building blocks of life and it does not harm human tissues. It is previously demonstrated that far UVC of 222nm light efficiently kills air borne influenza virus and they extend those studies for airborne human corona virus alpha HCOV-229E beta HCOV-0C43. Low dose of 1.7 and 1.2 mj/cm2 inactivated 99.9 percent of aerosolized coronavirus 229E OC43. Even human corona virus has same genomic size, thus far UVC is expected to show similar results of inactivation of them including human coronavirus SARS-COV-2. Beta HCOV-OC43 results shows expose limit(3MJ/cm2/hour) would results in 90 percent viral inactivation in 8 min , 99 percent in 11 min and 99.9 percent in 16 min. SOURCE**: SCIENTIFIC REPORT**

III. PROPOSED MODEL

As per the current scenario each individual focuses more on its health and immune system and also ensures taking safety precautions from getting infected from the COVID-19 virus. This project will help us meet the above challenges in a productive and efficient manner without any damage or loss to one's health. As per the scientists, this virus stays active on various surfaces for upto 3 days, so this project ensures the complete sanitization of the objects used in our day to day to life within seconds using UVC light and various other components. ARDUINO : The Arduino board is the central unit of the system. All the components are interfaced to the board and programmed as per their functionality to operate in synchronization. OBJECT SENSOR : It is used to sense the object to be sanitized. The analog output of which is applied to the Arduino board. THERMAL SENSOR : It is placed just besides the object sensor on both the ends to sense the human body part to prevent the skin from getting burnt or infected from the UVC light. RELAY MOTOR : It is used to control the direction and speed of the conveyer belt on which the object will be placed. UV LIGHT : It is used to sanitize the object thoroughly from all directions.

- Objects are sanitized thus reducing the risk of getting infected from contaminated objects and surfaces.
- The process of sanitization is completed within seconds ensuring the inactivity of the virus.
- Portability and lightweight features make transportation easy.
- The detachable unit can be used in households for disinfecting walls and other large equipment.
- Useful for all types of industries like Medical, Education, Household, Banking etc.
- Cost effective thus available even at the most backward areas.
- Easy to operate and maintain the system.

Ultraviolet Means `` beyond violet"(from latin ultra,"beyond"), violet being the color of the highest frequencies of visible light. Ultraviolet has higher frequency and thus shorter wavelength than violet light.UV is form of electromagnetic radiation with wavelength from 10 nm (30phz) to 400 nm(750THz).It is present in sunlight and constitutes about 10 percent of total electromagnetic radiation output from the sun,It can also be created artificially and it is used in industries. Ultraviolet rays are invisible to most humans. The lens of the human eye blocks most radiation in the wavelength range of 300-400 nm shorter wavelengths are blocked by the cornea, Humans lack Color receptor adaptations for UV rays. The reason why UV radiation is effective in disinfection is because As short wavelength UV produces high energy which is capable of breaking chemical bonds present in DNA. The uv-c radiation in the range of 260 nm-275 nm destroys the genetic information stored in DNA and cellular RNA, As RNA and DNA are building blocks for pathogens to survive such as virus and bacteria. Thus without this genetic material these pathogens are unable to reproduce.

TYPES OF UV

UV A	**UV B**	**UV C**
UV A rays are the rays with wavelength ranges from 315-400nm and 50 percent part of this ray gets absorbed by the ozone layer.	UV B rays are the rays with wavelength ranges from 280-315nm and 90 percent part of this ray gets absorbed by the ozone layer.	UV C rays are the rays with wavelength ranges from 100-280nm and 100 percent part of this ray gets absorbed by the ozone layer. UV-C light is germicidal

A. UV EXPOSURE TIME

The average bacterium will be killed in ten seconds at the distance of six inches from the lamp. The UV dose which will be delivered to the microbial population can calculated as follows

• UV dose = UV intensity w/cm2 × exposure time (seconds) UV intensity is inversely proportional to the square of the distance so it decreases as distance increases. It can rapidly increase at distances shorter than 1m. High intensities for a short period and low intensities for a long period are fundamentally equal in lethal action on bacteria. The inverse square law applies to germicidal ultraviolet light as it does to light; the killing power decreases as the distance from the lamps increases. The average bacterium will be killed in ten seconds at a distance of six inches from the lamp in an American Ultraviolet Germicidal Fixture.

1) DISTANCE BETWEEN LIGHT AND OBJECT:

Formula for how fast Energy drops is given by E(d) = P/d2 • The UV intensity is specified for each lamp at distance of 1m, Intensity rapidly increases at a distance shorter than 1m • 40 watt UV-C tube source has sufficient radiation upto 6 feet to kill organisms • 15 watt lamp can cover distance upto 100sq

feet • American ultraviolet says virus can be killed with in 10 sec at distance of 6 inches from lamp

A.HARDWARE DESIGN

CONVEYOR BELT : Conveyor belts are tried-and-true energy saver designed to increase efficiency. A conveyor system systematically carries materials, typically in industrial or controlled environments. A conveyor belt has two motorized pulleys that loop over a long stretch of thick, durable material; when motors in the pulleys operate at the same speed and spin in the same direction, the belt starts moving between the two. If objects are heavy, bulky or if the conveyor belt is carrying them for long distance or duration then it can cause sagging, to prevent the belt from sagging rollers may be placed on the sides of conveyor belt for support.

REFLECTOR: It is a polished surface for reflecting light or other radiation.

TYPES OF UV REFLECTOR

- Polished aluminum
- Dichroic coated aluminum
- UV coated quartz From above these three types of reflectors we are going to use polished aluminum that is aluminum foil.
- Polished aluminum (Aluminium foil) :Aluminum is the only material that has a high reflectivity against ultra-violet rays in a wavelength range of 250 nm to 400nm. It is light weighted and has high workability and such properties are required for ultraviolet reflection with very low loss. It provides an ultraviolet reflection having a higher reflectivity of 85 percent or more for ultraviolet rays in the wavelength range of 250 nm to 400 nm and 80 percent or more for deep ultraviolet rays in the wavelength range of 254 nm to 265 nm than the conventional aluminum foil.

INFRARED PROXIMITY SENSOR : A IR sensor is used to detect the nearby object without any physical contact. A IR sensor emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object that is sensed, is often referred to as the proximity sensor's target.Different proximity sensor demands target demands different sensors. For example a capacitive proximity sensor or photoelectric sensor is suitable for a plastic target and an inductive proximity sensor demands a metal target.

An IR Sensor has a Transmitter led and an Receiver(IR Photodiode) and together known as photo-coupler or opto-coupler. When an IR Transmitter emits radiation, it reaches the obstacle and some of it reflects back to the receiver. Based on the intensity of reception by the IR receiver, the output of the sensor is defined.

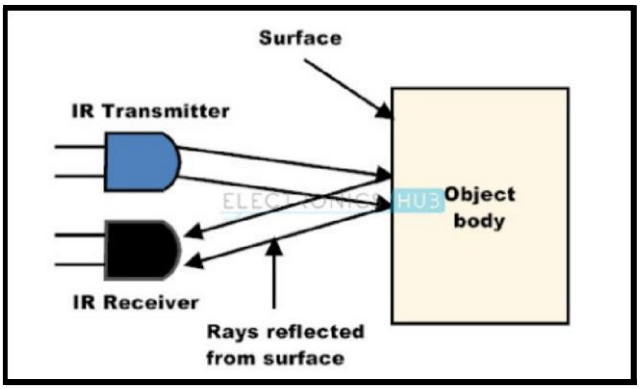

Fig. 1 Working of IR sensors

C.MICROCONTROLLER(ATMEGA328P)

The ATmega328p is a high performance, low power microcontroller from a controller. It is 8-bit AVR RISC based microcontroller combines 32 KB ISP flash memory with read-while write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

The basic working of CPU of ATmega328:-

- The data is uploaded in serial via the port (being uploaded from the computer's Arduino IDE). The data is decoded and then the instructions are sent to the instruction register and it decodes the instructions on the same clock pulse.
- On the next clock pulse the next set of instructions are loaded in the instruction register.
- In general purpose registers the registers are of 8-bit but there are 3 16-bit registers also.
- 8-bit registers are used to store data for normal calculations and results.
- 16-bit registers are used to store data of timer counters in 2 different registers. Eg. X-low X-high. They are fast, and are used to store specific hardware functions. item EEPROM stores data permanently even if the power is cut out. Programming inside an EEPROM is slow.
- Interrupt Unit checks whether there is an interrupt for the execution of instruction to be executed in ISR (Interrupt Service Routine).
- Serial Peripheral Interface (SPI) is an interface bus commonly used to send data between microcontrollers and small peripherals such as Camera, Display, SD cards, etc. It uses separate clock and data lines, along with a select line to choose the device you wish to talk to.

- Watchdog timer is used to detect and recover from MCU malfunctioning.
- Analog comparator compares the input values on the positive and negative pin, when the value of positive pin is higher the output is set.
- Status and control is used to control the flow of execution of commands by checking other blocks inside the CPU at regular intervals.
- ALU (Arithmetic and Logical unit)The high performance AVR ALU operates in direct connection with all the 32 general purpose working registers. Within a single clock cycle, arithmetic operations b/w general purpose registers are executed. The ALU operations are divided into 3 main categories – arithmetic, logical and bit-function.
- I/O pins The digital inputs and outputs (digital I/O) on the Arduino are what allow you to connect the Arduino sensors, actuators, and other ICs. Learning how to use them will allow you to use the Arduino to do some really useful things, such as reading switch

and triggers the conveyor belt motor and also decides the direction of motion depending on which sensor has detected the object and switches on the UV light.

- In order to sanitize the product from all directions, we are using aluminum coating sheet as the reflecting material which maintains the uv dose from all angles and thus it effectively inactivates the viruses, bacteria and other microbes by attacking

II. WORKING PRINCIPLE

● Sensor senses the object placed on the conveyor belt and triggers the conveyor belt motor and also decides the direction of motion depending on which sensor has detected the object and switches on the UV light.

● In order to sanitize the product from all directions, we are using aluminum coating sheet as the reflecting material which maintains the uv dose from all angles and thus it effectively inactivates the viruses, bacteria and other microbes by attacking their DNA, RNA and ending its ability to reproduce.
● We are also using a conveyor speed regulator in order to automatically control the speed of the conveyor belt for keeping the product under UV exposure for more than 10 sec. angles and thus it effectively inactivates the viruses, bacteria and other microbes by attacking their DNA, RNA and ending its ability to reproduce.

● We are also using a conveyor speed regulator in order to automatically control the speed of conveyor belt for keeping the product under UV exposure for more than 10 sec.

V. RESULTS AND DISCUSSIONS

Ultraviolet radiation applied for 120 s using the UVSC equipment was effective in disinfecting slides inoculated with four microorganisms involved in healthcare-associated infections such as P. aeruginosa, E. coli, S. aureus and C. albicans. The effect was even greater against spore-forming B. subtilis, obtaining an effect similar to that of 70% ethanol and 2% chlorhexidine. UVSC achieved a high reduction in the microbial burden when treating discs of several materials usually present in objects of medical practice, and/or daily use (borosilicate, polycarbonate, polyurethane, silicone, Teflon and titanium) in both conditions, being the reduction higher than 99.95% in borosilicate, Teflon and titanium, as well as 70% ethanol and 2% chlorhexidine. In conclusion, the UVSC equipment is a promising alternative for implementing disinfection protocols in hospitals and other health care settings to inanimate objects that can be used both inside and outside these settings, thus reducing risk of infection transmission.

VI. FUTURE SCOPE & CONCLUSION

Modules in the System :This system includes an Arduino module, two sensor modules, a relay motor controller module, and a UV light controller module. The sensor modules used in this system are generally IR proximity sensors which are placed at both the extreme ends of the system or model. The sensors play an important role in the model as they are used to sense the objects placed on the belt and accordingly on/off the UV light which is the main highlight of our project. Relay motor controller module comes into picture after the sensor module senses the object and feeds the information forward i.e as per the code or program written or fed into the system. After receiving information from the sensor module the relay motor gets started in respective direction i.e clockwise or anticlockwise with respect to the sensor from which it receives the information. UV light controller module is the main or the key element of our project as without it our project would be of no use. As soon as the sensor module sends information the motor as well as the UV light gets activated for a certain amount of time i.e the time which is enough to sanitize an object thoroughly. And after sanitization it automatically turns off on its own.

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