

Robotic Controlled UVC Sanitization Device

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Abstract— The pandemic situation in 2019 due to the Corona virus termed as Covid-19 by WHO has placed everyone in anxious situation. We were in this situation for last 2-3 years that we never even thought about. Global issue of Corona pandemic disturbed human life. Situation become again normal after 2-3 years, but people now worried about that pandemic or that corona virus at workplace they will be in dwell mind situation whether to touch things or not. It affects their mentality and may it indirectly effect on global economy. In this research to avoid such a situation to think develop Robotic Device along with Ultra Violet (UV) based system for sanitization of any surface such a as hospital, malls, colleges, etc. without directly touch. This simple yet effective system is easy to setup and less cost also.

Index Terms—UVC bulb, sanitization, Bluetooth module, Arduino UNO, Covid-19.

I. INTRODUCTION

The current situation of Covid-19 pandemic, cleaning and disinfection steps are critical and challenging. Other hand manual or physical cleaning is much risky and inappropriate which further increases risk of spreading virus. And still many parts of world experiencing or being threatened with more waves of new Covid-19 cases. The health care systems across the world constantly trying to finding method of stop Covid from spreading. Healthcare workers work endlessly to see a better world tomorrow. They are constantly working for give us safe surrounding.

Similarly, colleges, school, malls, hotels etc. have a similar goal i.e to open this while keeping staff, student, and customers comfortable and safe. However, very few peoples received the right training in how address issues presented by pandemic situation. All this problem is stuck in only one thing that 'How to adequately clean our surrounding?'

So, to overcome this problem we have developed and fabricated 'Robotic Controlled UVC Sanitization Device'. The idea in this project helps in the battle against the spreading of Covid-19. In this paper we present our idea to sanitize places in efficient way. Efficient way that actually means by using Ultra violet bulbs for sanitization. Nearly all of today's professional facilities use germicidal bulbs to keep their workspace germs free. UVC light disinfection is effectively used in recently to reduce spread of bacteria which is much more popular in hospitals, offices, restaurants, etc. because of their unriskey and touchless operation. UVC bulb is special type of lightning product which kills DNA or RNA of microorganism and prevents the virus particles from making more copies of themselves. It delivers UV rays between 100nm to 280nm on ultraviolet

Spectrum. To avoids or minimize use of chemical agents which is aggressive for surface and which makes impact on environment UVC bulb is so helpful. We constructed UVC device that includes microcontroller, arduino UNO board. This microcontroller is used for operate a system. This UVC circuit employed on Robotic car which second most important and effective part in this project. As the pandemic situation keep in mind it is very important to make device touchless. So that robotic car assures our safety and makes a process touchless. Use of Robotic car reduces risk of human contact with viruses, provides more safety and decreases the chances of getting infected by bacteria. It is run through remote control. Commands through the remote used for controlling robot in all directions such as forward, reverse, left, right with help of a DC motor.

The system has several advantages over chemical based sanitizing method (Wet) is automatic and touchless operation. It is also economical. We are aware to the fact that every office, hospitals, restaurants, etc. requires this kind of equipment which is easy to use and provides untouchable sanitization process and give us greater efficiency through UVC bulb.

2. LITERATURE REVIEW

Robots have wide use in Health care areas. These robots are uses drifting machines, drones for transportation of important or different medical instrumentation. Socially conscious robots utilized in the supervision of physically / mentally restricted individuals, and industrial robots like those want to sterilize patient area or offer delivery. A few robots are presently within procedure of evaluation and development. The comfort of robots can rely upon many variables such as a person, culture, particular software or a business. To clear up the clinic disinfection disadvantages, many style requirements had to be enforced. There are a lot of design requirements for a robotic disinfector and more if the robots are to operate in a clinic. Mobile system based on UVC radiation has been used for cleaning and disinfection hospitals, school classrooms, malls etc. The contribution of this equipment to the conditioning of class areas makes these systems useful for other kinds of spaces that require periodical disinfecting. The spaces which requires control of presence of microorganism need effective, fast and economical controls, also, that can be used on a frequent basis. Most of the available equipment use low pressure mercury lamps to produce UVC radiation. In addition, the equipment can operated from a wide range of Android mobile devices with suitable processing capacity. This technology is not only use now but rapidly developing and maturing. A few analysis paper associated with medical reports are been studied and they show influence of management of good health profession.

The paper of Pacharawam Chanprakon [1] of “An Ultraviolet sterilization mechanism for disinfection” has developed an ultraviolet radiation mechanism for sterilization in an operative or patient room. Their ultraviolet radiation larva has three 19.3 W of LED mounted on platform.

The paper of Thomas Rubaek [2] of “Evaluation of The UVC Disinfection Robot “has developed UV disinfection robot to decrease the spread of diseases and hospitals acquired infection. This robotic is used for disinfect location in healthy facilities and other environment this robot is designed as an addition to existing cleaning cycle.

3. METHODOLOGY

AJ UVC Disinfection:-

Public health concern such as Tuberculosis, pandemic influenza and acute respiratory syndrome has stronger effect to prevent transmission of infection using environment controls by Governments. One of such control is Ultraviolet germicidal radiation. UVC lamp is also called ‘Germicidal Lamp’. Ultraviolet technology is non-chemical approach to disinfection. Ultraviolet rays separated into three basic categories UVA, UVB, UVC.

- ❖ Wavelength: - UVA = 315nm-400nm
UVB = 280nm-315nm
UVC = 100nm-280nm

There is some evidence that UAB radiation is effective at inactivating other SARS virus. However, it is less effective than UVC and more hazardous to humans. UVA radiation is length less hazardous than UAB radiation but is also less effective than UVC for inactivating viruses. UV light is electromagnetic radiation with wavelength shorter than visible light but larger than X-rays.

- ❖ Invention of UVC lamp :-

In 1845 it was known that the first microorganism respond to light. But in 1877 Downes and Blunt discovered the antibacterial effect of shorter wavelength of sunlight. When they observe that exposing test contain posture’s solution to sunlight prevented growth of microorganism inside the tube and after some time, with increased exposure duration the test tube remain bacteria free for several months. Shortly then after it is proven that the ways rays were able to destroy microorganism.

- ❖ Construction of UVC bulb :-

UVC bulbs are of low pressure which contains mercury. Mercury provides the UV radiation necessary to reach optimum wavelength. UVC bulbs are filled with either argon gas or mixture of rare gases including argon, neon or other gases depending upon germicidal requirements. They are constructed similar to florescent lamp.

- ❖ Lamps body made of either –

I] VH glass – pure fused quart zed that will transmitted 254nm.

II] L glass – quartz with titanium added to block out 185nm

III] N glass – made of soft glass transmitted 254nm

❖ Following lamps that are produce UVC radiation :-

I] Low pressure mercury lamp - most commonly used lamp which produce UVC radiation with low pressure mercury lamp, Wavelength is 254nm.

II] Excimer lamp – Wavelength is 222nm.

III] Pulsed xenon lamp - this lamp are emit short pulse light. This are normally employed when there are no human in space.

IV] Light Emitting Diode – that produce UV radiation with very short wavelength – 265nm, 273nm, 280nm. One advantage of LED over low pressure mercury is that it is not contain mercury which is hazardous.

❖ Working Principle of UV Light :-

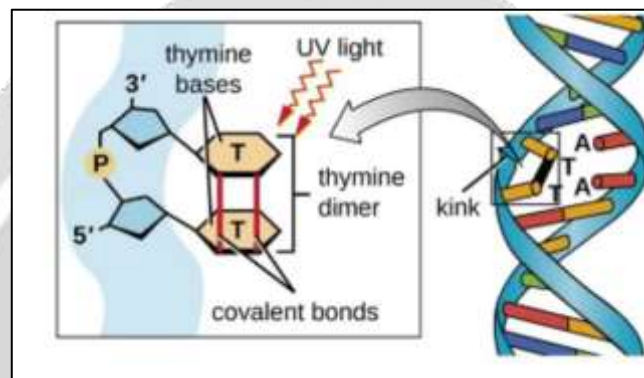


Fig: 1-Working principle of UV rays

UV rays are powerful and effective in destroying viruses and other bacterial microorganism present in air, water, surface and moisture. UV light kills microorganism by destroying nuclei and disturbing DNA or RNA of viruses so, leaving them unable to perform vital cellular functions and hence stop them from multiplying further that means they are effectively dead. UVC lamp operate through electrochemical process .An electrical discharge through argon gas strikes a mercury vapor to generate a photon with wavelength 253.7nm which is invisible .The effectiveness of UV rays depends on duration of microorganism is exposed to UV wavelength and microorganism ability to withstand UV during exposure.

❖ Thymine Dimer Phenomenon:-

When any viruses or bacteria or an organic pollutant comes in contact with UV rays, UV rays will enter into the cell membrane and nucleus of virus. Then UV rays are absorbed DNA or RNA and act photo chemically. After that genetic material of cells changed so that activity of genetic material of cell is last and hence microorganism cannot further reproduce or will soon die. That means UV rays are destroy biological regeneration ability of viruses and this is very important because bacteria can multiplies 100 or even millions of bacteria within 24 hrs.

In this project we use UVC bulb which had short wavelength 100-280nm. Those bulbs require 12V DC supply bulbs attached to arduino pin through relay. This overall assembly employed on robotic car.

❖ Germicidal UVC lamps are also used for following sterilization purpose :-

1. Air – UV air sanitization is important in hospital to improve health of people who suffer from illness like Asthma and prevent the spread of infection. System including upper room ultra violet germicidal radiation and this system is also healthful at places where peoples suffer from limited ventilation.
2. Water – UV lamps also provide safe, efficient way to treat water hence no need to use harmful chemicals. They are used for water purification of west water, industrial and commercial processed water.
3. Surface – UV lamps helps to prevent the spread of diseases. Surface sterilization is highly important in hospital and also in restaurant, airport etc.

B] Hardware:-

Robotic car – to design robotic car we integrate different hardware components as follows-

I] DIY Arduino – Do It Yourself arduino requires following minimum system build the arduino by itself.

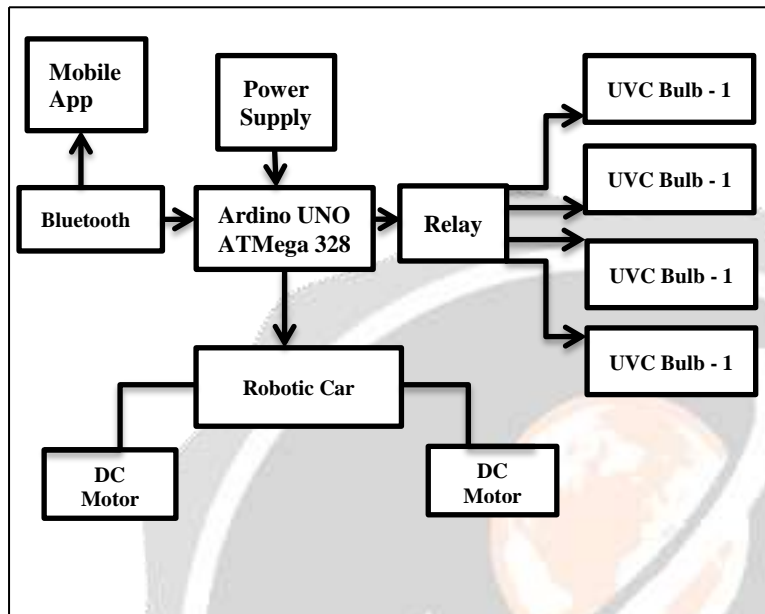


Fig: 2 – Block diagram of UVC sanitization device

II] Arduino - In our project we use AT MEGA 328P Microcontroller. This IC is at the center of arduino UNO board. It acts as a microcontroller of 8 bits that control and interact with sensor, motor, relays and other electronic devices. AT Mega 328P has 32KB internal flash memory it has 1KB EPROM and 2KB RAM. Operating voltage from 1.8V to 5.5V but normally we use 5V as a standard. Number of pins is 28. 8MEGA 328P Microcontroller is cost effective, low power consumption, programming lock for security purpose. It also has 14 digital input/output pins, 6 analog inputs, a 16 MHZ ceramic resonator, a USB connection, a power Jack, an header and reset button.

III] Voltage Regulator – The voltage regulator is component of power supply unit which maintenance fixed output voltage. We used here 7805 voltage regulator with capacitor filter to produce a permanent DC power supply of 5 volts. The main purpose of using input and output capacitor with IC 7805Votlageregulator is to remove or filter the AC noise. It has 3 pins namely input, output and ground

IV] Clock circuit – For a microcontroller work, it needs a clock circuit. The clock circuit determines the speed with which microcontroller operates. How many instructions per second it will execute are depend on the close frequency? Here we used 16 MHZ crystal oscillator and two capacitor of 22 PF.

V] Reset Circuit – The reset circuit used to reset ATMega 328P microcontroller. It is connected to reset pin of Arduino. Here we used 10K register and switch for reset circuit of arduino. When the switch is pressed, pin is pulled to ground and arduino chip will reset.

VI] Test LED Circuit – LED and register is used for test circuit which confirms whether your microcontroller is on/off. The LED is connected to pin number 13th of microcontroller and hence it checks and gives signal to you about microcontrollers operating condition.

VII] Power Supply – Power supply provide to electricity to device on which the components are able to

operate. We give 12volt supply to arduino by using battery. The battery is an integral part of transmission module.

VIII] Relay – It is electromechanical switch used to turn ON and OFF circuit and used to provide isolation between the UV bulb and microcontroller

IX] Motor drive module- It is used for two motor to drive the robot. .

X] DC motor – Dc motor is used for the movement of robot where it is connected with the motor drive. Whenever the trigger signal is given to the motor drive then the motor moves according the trigger with given speed.

XI] Bluetooth Module – the Bluetooth technology manages -
The communication channel of the wireless part. The Bluetooth module can receive and transmitters the data from
A host system with the help host controller interface. It provides arrange of up to 10mtr at a transmmite power of 1meter watt. The range can be extended to 100 meter. If the transmmite power is increased to 100 meter watt. Android phone and Bluetooth decoder attached unrobot is used to control the robot movement. The Bluetooth decoder install the in the robot should be connected with android phone. Every cell phone key is assigned a specific task. After connection, if the button is pressed, the corresponding button code is transmitted to the Bluetooth decoder. With the help of Bluetooth decoder, the microcontroller will process the receive code.

The android app used is Bluetooth SPP pro which is available on android mobile. Each key of the mobile assigned a particular job.

4. OPERATION

Project we are presenting here is cost effective, portable UV sanitization robot. The robot is suitable for any type of floor and is operated by Bluetooth technology. The robot is provided with and android control which uses Bluetooth communication in this project we use microcontroller, arduino UNO, Bluetooth module, motor drive, DC motor, Relays and most important UVC bulb.

UVC bulb which is used for the destroying pathogen and other bacteria presented in surrounding. Motor is connected power supply via relay and switched ON by electronic trigger generated from arduino. This is controlling by microcontroller which has 28 functional pins when we switched on the supply through relay which is operated by mobile (remote). Then motor will start. Each key of mobile is assigned a particular job like DC motor forward reverse left, right and relay on/off. So we make this overall assembly touchless and moveable for sanitization. UVC bulb operates on 12V DC supply when UVC bulb switched on sanitization process starts and device start working.

5. CONCLUSION

The current Covid-19 situation boosts innovation on much public, social and medical level and also on disinfection practices. The creation of clinical robots is increases safety and standard of health control system. Keep this thing in mind we develop sanitization device to perform disinfection of objects or floors. The main objective of our work is to provide an alternative source for disinfection process of public as well as personal space.

We had idea to replace the current method of using chemical disinfection system and manual cleaning. Ultraviolet sanitization is latest disinfection technology. This UVC device navigates manually via a wireless remote control. Cleaning with automatic UVC sanitization system which would requires minimum human existence. Our UV is able to move around a room and avoiding obstacles by using a wireless control. This whole device is unrisky, economical, and simple in structure

6. AKNOWLEDGEMENT

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valuable suggestion imparted to us during work, thereby providing us to all necessary information for designing and developing the project

7. REFERENCES

- [1] Pacharawam Chanprakon, Tapparat sae-oung Treesukon of “An Ultraviolet sterilization mechanism for disinfection”IEEE Explorer , August 2019
- [2] Thomas Rubaek, Merriam Klikotic, Simon Falden of “ Evaluation of The UVC Disinfection Robot “

