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Design and Construction of a UV-C Sterilization System Using the Arduino System

Abd AL-Qader Mohammed Faris*
* B.Sc. in Medical Instrumentation engineering, Baghdad, Iraq
Email: engabdulqadeermfaris@gmail.com

Abstract:
UV-C defines the ultraviolet radiation with wavelength range of 280 to 100 nanometres. Most people have heard of the dangers of UV-A (400 – 315 nm) and UV-B (315 - 280 nm) exposure from the sun or from sunbeds. UV-C is also produced by the sun, but it is the shortest of the ultraviolet wavelengths and is almost entirely filtered out by the atmosphere before reaching the earth's surface. Therefore, people have little or no natural exposure to it, and that's a good thing. The shorter the wavelength, the more impact ultraviolet radiation could have on human health. For this research, the working principle of the uv sterilizer, uv sterilizer set of optical, microbiology, machinery, electronics, fluid mechanics, such as designed on the basis of the principle of comprehensive science, with high efficiency, high strength and high life water strong uv ultraviolet germicidal lamps, when the bacteria, viruses and other water after uv irradiation.

Keyword: based Sterilization, UV-C Radiation, bacteria, Arduino, Reed Switch (NO).

1. Introduction

All of know about the COVID scenarios we can't talk freely; we can't walk freely because of the killer virus. and the only way to prevent this virus from spreading is by minimising the contacts and proper sterilization or sanitization with the help of a powerful and efficient ROBOT, we can achieve this very easily without exposing ourselves [1].

Enough exposure to UV-C radiation causes damage to DNA and RNA of the virus so they can't replicate, effectively killing or inactivating a virus. There are several reports claiming the effectiveness of UVC radiation on the new COVID-19. Few big companies have even launched their own UVC sterilizers [2].

We are using Arduino Nano for it Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything that Diecimila/ Duemilanove has (electrically) with more analogy input pins and on board +5V AREF jumper. Physically, it is missing power jack. The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper [2].

Nano's got the breadboard-ability of the Boarduino and the Mini+USB with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, GND on one top, power and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It is two layers. That make it easier to hack and more affordable [3]. Our project is interested in studying a device that has become very important at this time and during this epidemic to make sure that we take all necessary steps to stay away from this virus, as this device can be manufactured using a germicidal lamp UVC using Arduino [4].

2.System Components

The part responsible for this device and the most important part of it is the Nano, the Arduino is the one that controls all the device and how to operate the LED, and with it also a group of parts also it is important for the device, but we mention again who is responsible for this device and about this sterilization process is the Nano Arduino [5].

2.1 Arduino Nano

is a small, compatible, flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p (Arduino Nano V3.x) / Atmega168 (Arduino Nano V3.x). It comes with exactly the same functionality as in Arduino UNO but quite in small size[5]. [Fig.1]

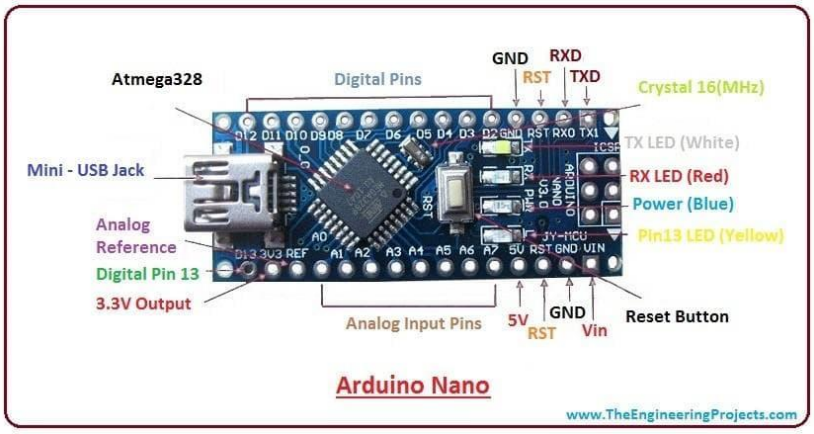

Figure-1- Arduino nano

It comes with an operating voltage of 5V; however, the input voltage can vary from 7 to 12V.Arduino Nano Pinout contains 14 digital pins, 8 analogy Pins, 2 Reset Pins & 6 Power Pins. Each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output. They are acted as input pins when they are interfaced with sensors, but if you are driving some load then use them as output [6].

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2.2 UVC Lamp Need

Figure -2- show that the OEM/ODM excellent quality UVC lamps since 2003. UVC lamps can be customised to any size, style, colour or usage design by your needs. All of them are made of eco-friendly and high-quality quartz glass, amalgam, plastic materials etc. As with light or radio waves, uv radiation is an electro-magnetic wave radiation (photon radiation), which is only different in wavelength to the other stated radiations [7].

Figure-2- Lamp need

UVC is the short-wave part of the ultraviolet radiation spectrum that is not naturally occurring on the earth. So, it must be produced artificially. UVC is the wavelength between 100 and 280 nm [8]. The shorter the wavelength the more energetic the radiation [9].

2.3 PCB SMPS

Switching power supply is a widely used power supply topology in power electronics shown in figure (3). Whether it can be a complicated CNC Machine or a compact electronic device, as long as the device is connected to some sort of power supply an SMPS circuit is always mandatory. Improper or faulty Power supply unit could lead to a big failure of the product irrespective of how well-designed and functional the circuit may be. We have already designed quite a few SMPS Power Supply circuits like the 12V 1A SMPS and the 5V 2A SMPS using the Power Integration and Viper controller IC respectively [10]

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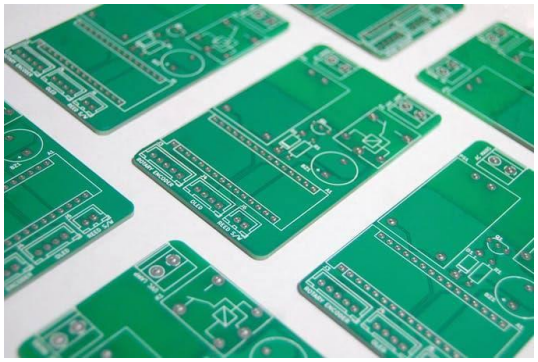

Figure-3- pcb smps

Every Switching power supply uses a switch like a MOSFET or a power transistor that constantly gets turned ON or OFF depending on the switching driver specification. The switching frequency of this ON and OFF state ranges from a few hundred kilohertz to megahertz range. In such a high-frequency switching module, the PCB design tactics are far more essential and it is sometimes overlooked by the designer. For example, a poor PCB design could lead to failure of the entire circuit as well as well-designed PCB could solve many unpleasant events[11].

2.4 Fuse Holder

fuse holders are devices for containing, protecting and mounting fuses. Fuse holders come in two basic types, open or fully enclosed. Open fuse holder types are fuse clips, fuse blocks, socket and plug-on cap varieties. The fully enclosed variety may use a fuse carrier that is inserted into a holder or have other means to fully enclose the fuse. cap varieties. The fully enclosed variety may use a fuse carrier that is inserted into a holder or have other means to fully enclose the fuse [12].

Figure-4- Fuse holder

2.5 SPDT Relay

The SPDT Relay(30A) is a high-quality Single Pole Double Throw Relay (SPDT). The Relay consists of a coil, 1 common terminal, 1 normally closed terminal, and one normally open terminal. When the coil of the relay is at rest (not energized), the common terminal and the normally closed terminal have continuity. When the coil is energized, the common terminal and the normally open terminal have continuity. This relay's coil is rated up to 5V and the contact is rated up to 30A (@250VAC, 30VDC). You can use it to control high current devices [11].

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Figure-5- spdt relay

2.6 Rotary Encoder

The RM08 is a compact, super small high-speed rotary magnetic encoder designed for use in harsh environments. The noncontact two-part design removes the need for seals or bearings ensuring long term reliability and simple installation.

The RM08 encoder has been designed for direct integration to high volume OEM applications and can be used in a wide range of applications including motor control and industrial automation [8].

- Super small size – 8 mm diameter body
- Accuracy to ±0.3°
- 3.3 V or 5 V power supply versions
- High speed operation to 30,000 rpm

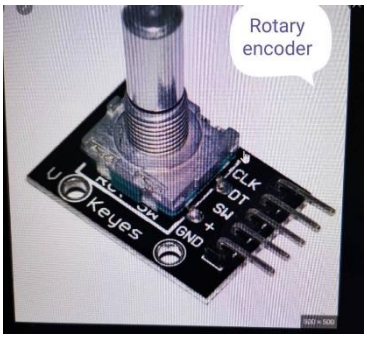

Figure-6- Rotary Encoder

2.7. The organic light-emitting diode

The organic light-emitting diode (OLED) display that we'll use in this tutorial is the SSD1306 model: a monocolor, 0.96-inch display with 128×64 pixels as shown in the following figure [3].

The OLED display doesn't require backlight, which results in a very nice contrast in dark environments. Additionally, its pixels consume energy only when they are on, so the OLED display consumes less power when compared with other displays [3]. The model we're using here has only four pins and communicates with the Arduino using I2C communication protocol. There are models that come with an extra RESET pin. There are also other OLED displays that communicate using SPI communication.

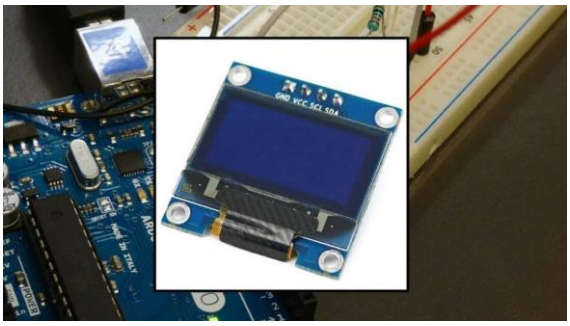

Figure-7- OLED (12C)

2.8 Piezo Buzzer

Piezo buzzers are simple devices that can generate basic beeps and tones. They work by using a piezo crystal, a special material that changes shape when voltage is applied to it. If the crystal pushes against a diaphragm, like a tiny speaker cone, it can generate a pressure wave which the human ear picks up as sound. Simple change the frequency of the voltage sent to the piezo and it will start generating sounds by changing shape very quickly![6].

Figure-8- piezo buzzer

2.9 Reed Switch (NO)

A reed switch is an electromagnetic switch used to control the flow of electricity in a circuit. They are made from two or more ferrous reeds encased within a small glass tube-like envelope, which become magnetised and move together or separate when a magnetic field is moved towards the switch. The switch effectively works like a gate, or a bridge, in an electric circuit so when the two reeds are in contact, electricity can flow around the circuit operating a device. Unlike mechanical switches they do not

require something or someone to physically flick them on or off, they are controlled completely by invisible magnetic fields [7].

Figure-9- Reed switch (no)

In a normally open switch, the two reeds, which are made from ferrous material such as a nickel-iron alloy are positioned so that they are not touching. When a magnet is moved close to the switch, it pulls one of the reeds towards the other so that they are touching, and therefore completing the circuit. Remove the magnet and the reeds return to their original position breaking the circuit [5].

3. Circuit Design

The block diagram of the complete design is shown in figure [Fig.10]. A system controlled by Nano Arduino that takes information from the sensor used to detect germs. Data analysis and corresponding light in light green, yellow or red color according to germs percentage.

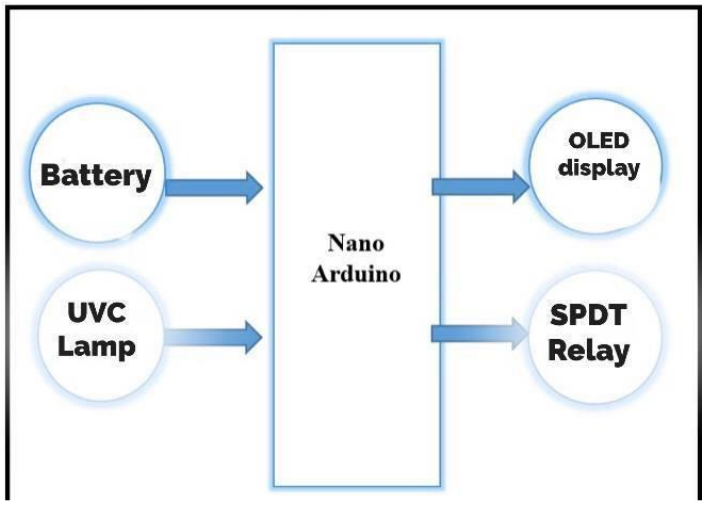

Figure-10- Block Diagram of project

The construction of the device and its components can be shown in figures (11,12). The test was carried out uv-lamp according to the schematic design. The process starts after the application is connected; the cabinet is ready to use.

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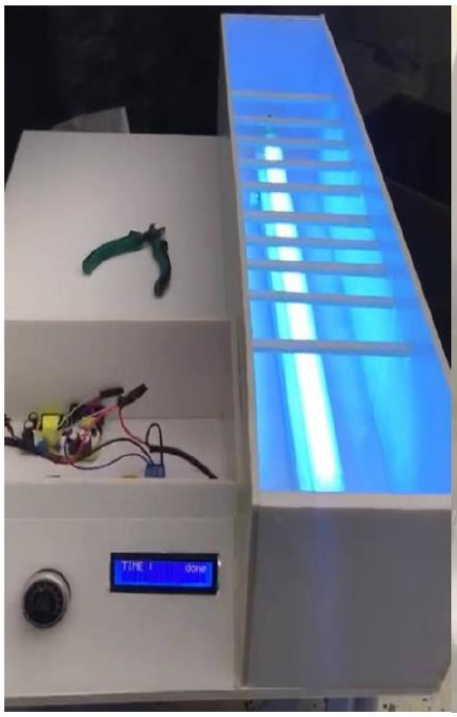

Figure-11-Device is on.

Figure-12- the components of device

As already stated, it is not a good idea for us to get exposed to UVC radiation frequently. Since the lamp will be in an enclosure made up of plastic which may absorb most of the radiation and prevent it from reaching us, there is a slight chance of radiation leaking through it. I'm not an expert on this so it is better to be safe. I will be using aluminum tape to cover the inside of the enclosure where the light will hit. This will also help in reflecting the light evenly. A magnetic reed switch will be used as an extra step to safety such that the lamp will turn/remain ON only when/till the door is closed [13]. Schematic diagram of UV-C Sterilizing can be shown in figure (13).

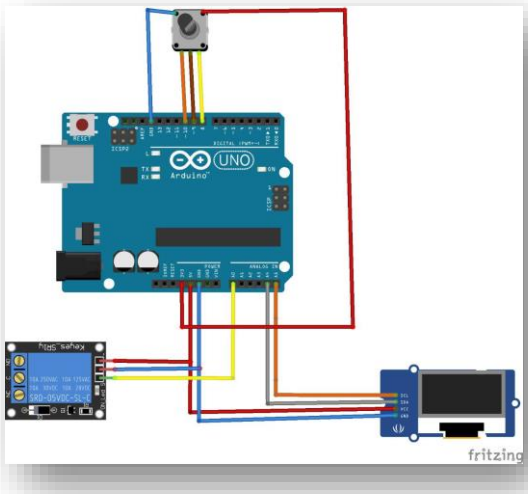

Figure-13-Schematic diagram of UV-C Sterilizing

4.Principal work of the device and data collection.

UV-C sterilizer principle is when water after irradiation sterilizer, to kill the bacteria, viruses and other organisms in the water.

In the process will not change its physical and chemical properties, also won't produce secondary pollution, the advantages of the equipment operation is simple, is used by more and more industry.

Working principle of the uv sterilizer, uv sterilizer set of optical, microbiology, machinery, electronics, fluid mechanics, such as designed on the basis of the principle of comprehensive science, with high efficiency, high strength and high life water strong uv ultraviolet germicidal lamps, when the bacteria, viruses and other water after uv irradiation, the cell structure of DNA and was damaged, cell regeneration, so as to achieve water disinfection, sterilization and purification effect.

*ultraviolet radiation sterilization equipment installation steps:

1. Before installation domestic ultraviolet disinfector, points shall be installed to measure voltage, to ensure that the electronic ballast can work normally;
2. The uv light sterilizer device is installed in a safe position, in order to avoid equipment falling damage to internal parts, more serious safety accidents;
3. Water after in and out of the hole link and correct, and then visual procuratorial household uv light sterilizer equipment each joint leakage, if there are no leaks can pass on the power supply.

* Installation and maintenance matters needing attention:

1. If the water too fast, please limit flow and pressure limiting device;
2. And often closed solenoid valve or move, please install the solenoid valve’s hole;
3. Household uv disinfector lamp at work, do not eyes look straight tubes;
4. If the raw water turbidity add profiteer during more than 5 degrees, to ensure that the ultraviolet sterilization effect;
5. If the vertical installation, use water to slow the flow of water intake high speed, low increase ultraviolet irradiation effect;
6. use every two to three months, please remove the quartz sleeve, examine the surface fouling phenomenon, in order to determine the next clean surface of quartz tube.

Many of us have heard about uv light lamp and seen some of these units in operation in uv disinfection lamp, uv sterilization lamp and uv disinfection lamp spaces.

To live healthy, you need to eat healthy; to eat healthy, you need to think healthy; to think healthy, you need to read health; to read healthy and you need to follow Tepro UV Lamps.

These uv sterilization lamp uv light disinfection are not only useful but also more cost effective than those traditional ones.

It's the consistent experience that builds trust and loyalty. Creating a personality and platform that is scalable will allow you to evolve uv sterilizer aquarium with your consumers.

Sterilizing light, is an alternative product for uv disinfection lamp to investors and consumers who are passionate about our products or services.

Conclusion

Based on the process of design, manufacture, observation and test results, several conclusions can be drawn for the progress, improvement and development of the application of this system. the following conclusions can be drawn:

- A remote UV-C sterilizer can be used to sterilize people with Corona disease.
- As it will help in avoiding the transmission of infection between infected people and treating doctors, thus reducing or reducing disease transmission between people.
- The important step has been taken towards applying this technology. If needed, remote virus detection and sterilization function can be combined. The study is relevant to patient monitoring systems.

References

1. Amoah, K., Craik, S., Smith, D.W. and Belosevic, M. 2005. Inactivation of Cryptosporidium oocysts and Giardia cysts by ultraviolet light in the presence of natural particulate matter, AQUA, J. Wat. Supply 54(3): 165-178.
2. Ballester, N.A. and Malley, J.P. 2004. Sequencial disinfection of adenovirus type 2 with UV-chlorinechloramine, J. Amer. Wat. Works Assoc., 96(10): 97-102.
3. Batch, L.F., Schulz, C.R. and Linden, K.G. 2004. Evaluating water quality effects on UV disinfection of MS2 coliphage, J. Amer. Wat. Works Assoc., 96(7): 75-87.
4. Battigelli, D.A., Sobsey, M.D. and Lobe, D.C. 1993. The inactivation of Hepatitis A virus and other model viruses by UV irradiation, Wat. Sci. Tech., 27(3-4): 339-342.
5. Belosevic, M., Craik, S.A., Stafford, J.L. Neumann, N.E., Kruithof, J. and Smith, D.W. 2001. Studies on the resistance/reaction of Giardia muris cysts and C. parvum oocysts exposed to medium-pressure ultraviolet radiation, FEMS Microbiol. Lett., 204(1): 197-204.
6. Bolton J.R. and Linden, K.G. 2003. Standardization of methods for fluence (UV Dose) determination in benchscale UV experiments. J. Environ. Eng. 129(3): 209-216.
7. Bukhari, Z., Abrams, F. and LeChevallier, M. 2004. Using ultraviolet light for disinfection of finished water, Water Sci. Tech., 50(1): 173-178.
8. Caballero, S., Abad, F.X., Loisy, F., Le Guyader, F.S., Cohen, J., Pinto, R.M. and Bosch, A. 2004. Rotavirus virus-like particles as surrogates in environmental persistence and inactivation studies, Appl. Env. Microbiol. 70(7): 3904-3909.
9. Campbell, A.T. and Wallis, P. 2002. The effect of UV irradiation on human-derived *Giardia lamblia* cysts, Wat. Res., 36(4): 963- 969.
10. Carlson, D.A., Seabloom, R.W., DeWalle, F.B., Wetzler, T.F., Engeset, J., Butler, R., Wangsuphachart, S. and Wang, S. 1985. Ultraviolet disinfection of water for small water supplies. US EPA Report No. EPA/600/S2-85/092.

11. Cass AL, Kelly JW, Probst JC, Addy CL, McKeown RE. Identification of device-associated infections utilizing administrative data. American Journal of Infection Control. 2013; Published online 17 June 2013.
12. Chang, J.C.H., Osoff, S.F., Lobe, D.C., Dorfman, M.H., Dumais, C.M., Qualls, R.G. and Johnson, J.D. 1985. UV inactivation of pathogenic and indicator microorganisms, Appl. Environ. Microbiol., 49(6): 1361-1365.
13. Clancy, J.L., Bukhari, Z., Hargy, T.M., Bolton, J.R., Dussert, B.W. and Marshall, M.M. 2000. Using UV to inactivate *Cryptosporidium* – Even extremely low dosages of ultraviolet light can be highly effective for inactivating *Cryptosporidium* oocysts, J. Amer. Wat. Works Assoc., 92(9): 97-104.