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Automatic UV Disinfection System with Conveyor

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Abstract 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. We cannot apply sanitizers on fruits, vegetables, packed food, batteries etc. we buy from outside or we can't sanitize files, paperwork that doctors exchange with patients or employees exchange with each other. Many researchers are working on multiple aspects of the COVID-19 pandemic including disease detection, treatment, and Vaccine development. Well we solve this huge problem with Automatic UV Disinfection System with automatic conveyor. Now UV C Has Been Proven to kill The Viruses within the matter of seconds. UV C Used to kill the bacteria's and gums from the surface of Products like fruits, vegetables etc., and this proposed system addresses these challenges comprehensively. The proposed system is unobtrusive during its operation and can be operated even in the presence of people in the living spaces.

Keywords: Covid-19, UVC, Disinfection

1.INTRODUCTION

Global issue corona pandemic and lock down has slowed down the human life. The fear of infection through not only direct contact but also through surfaces likely to have been touched by infected persons has led to the cleaning of packets, containers and even vegetables with soaps and detergents. It is notable that ingestion of detergent and similar molecules itself can pose problems to human body. Thus, there is a need for developing programmable disinfection units, which automatically move the packets to be sanitized on a conveyor belt from the entry end, hold them for specified period of time under UV irradiation and then move out to the delivery end. This system will stop the possibility of detergent /soap and such molecules entering the human body. The development of above-described unit will require developing codes (programs) for movement, holding and then again movement of conveyor belt to carry the packages from entry to delivery end of the proposed disinfectant system. The sensors at entry end, holding place (inside the enclosure) and delivery end will control the conveyor belt movement. Such systems will be needed in large numbers in different types of manufacturing units/factories, shops, stores for a non-touch disinfection of goods enclosed in packets. To this end, suitable codes/programs will be developed to integrate conveyor belt movement, functioning of UV light sources, and programmable holding time of packets/goods through appropriate sensors. The mechanical system will be fabricated using conveyor belt, motors, and controllers etc., contained in an enclosure. This enclosure will be fitted with UV light sources from different angles to enable disinfection of all surfaces of packets/goods. The corona epidemic may be overpowered soon but the need to disinfect surfaces likely to have been exposed to viruses will continue in future. Hence there is a need to develop the proposed disinfection units for different types of packages. Ultraviolet light in the germicidal range (200-280 nm light) known as "UVC" has proven to be effective at disinfecting water and surfaces, and may help reduce the risk of infection due to the COVID-19 virus. UVC light energy is not the same as the UVA and UVB light wavelengths found in exposure to sunlight. As per NJ TRANSIT's request, the purpose of this study is to test and provide validation support for a pilot UVC deployment. The research team was tasked to perform a Lieder survey of representative bus vehicles and model the placement of UVC light sources to quantify the surface areas that would receive UVC disinfection exposure. The team was also to perform field validation tests using a spectrometer to measure the intensity of exposure throughout the bus based on the recommended locations from the Lieder survey. Lastly, the team was to review potential air disinfection technologies within the context of published materials.

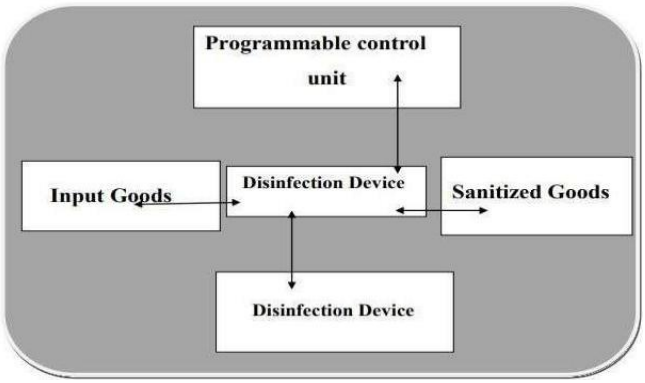


Fig.No.1 UV based automated disinfection

2. METHODOLOGY

Covid-19 pandemic situations as an Ultra Violet (UV) for the sanitization of object surface like products and other materialistic things. UV provides solutions for delivery products to the various companies like Amazon, r/////eliance mart and many more etc. from various disinfections. This involved three Stages: Disinfection

?devices (hardware assembling), and Programming of control unit. First of all, goods or materials placed into the disinfection device in proper way then control unit signal and auto switch on to start the UV light within device after few second hold sanitized goods released and all system govern through device program. Device consists of compact enclosure in which UV (ultra violet) light is fitted and a conveyor is passing through it. Conveyor is loaded with desired objects at one end of the enclosure and moved towards the other end of the enclosure, passing under sensor to recognize and identify the position of object and conveyor movement stops at the other end of the enclosure by the action of another sensor. The loaded conveyor will stop inside the enclosure for few seconds (55seconds) of time interval, this is the soaking period of UV light by the surface of the objects, then Factors, such as increasing awareness on the importance of health literacy in individuals, partly imparted by government bodies, amid the recent global spread of contagious diseases, such as COVID-19. In future the UV disinfection system Help to reduces the food borne illness and useful for the hospitals, malls, airports etc. As UV Rays are most effective to kill the bacteria's and gums therefore the UVC disinfection is best alternative of any other disinfection.

Disinfectant	Strengths	Weakness	Compatibility with materials
Natural sun light (mostly UV A and UV B)	Not very effective against viruses Does not use any chemicals	Requires long time of exposure (~ 15–30 min)	Compatible with all materials
UV-C (254 nm)	Very effective against bacteria and viruses Can be deployed at scale using the existing UV light sources that are used in the wastewater, swimming pools and medical facilities	Causes severe sunburns and is not recommended for direct human exposure at high dosages needed to inactivate the virii	Excellent: brass, stainless steel Very good: poly vinyl chloride (PVC) Good: high/low density poly ethylene (HDPE/LDPE)

Table No:1 Disinfection and Their Suitability

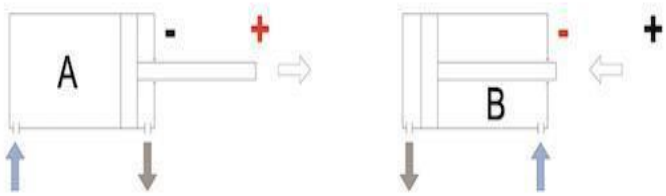
3. SYSTEM REQUIREMENTS

3.1 Double Acting Pneumatic Cylinder

2 cylinders each length 21 inches For Forward and backward moving One In Horizontal Direction And Another For Vertical direction & stroke size 10mm. A double-acting pneumatic cylinder uses compressed air to move a piston in and out.

Double-acting pneumatic cylinders are the most common type since they give the user complete control of the piston movement. the piston and piston rod move when compressed air enters the cap-end port and the rod-end port. A negative position is when the piston rod is retracted, and a positive position is when the piston rod is extended. When compressed air enters the cap-end port, it pushes the piston forward (positively), extending the piston rod. Air is forced out of the rod-end port. To retract the piston rod, air enters the rod-end port, forcing air out of the cap-end port, and forcing the piston to retract to the negative position

Fig.No.2 Double Acting Pneumatic Cylinder



3.2 Solenoid Valve

12 V, Dc it necessary To start or stops the flow in the cylinder to control Forward and backward movement. A solenoid valve is an electrically controlled valve. The valve features a solenoid, which is an electric coil with a movable ferromagnetic core (plunger) in its center. In the rest position, the plunger closes off a small orifice. An electric current through the coil creates a magnetic field. The magnetic field exerts an upwards force on the plunger opening the orifice. This is the basic principle that is used to open and close solenoid valves. An electronically operated solenoid valve is usually used for this purpose. By being solenoid actuated, solenoid valves can be positioned in remote locations and may be conveniently controlled by simple electrical switches. Solenoid valves are the most frequently used control elements in fluidics

Fig.No.3 Solenoid valve

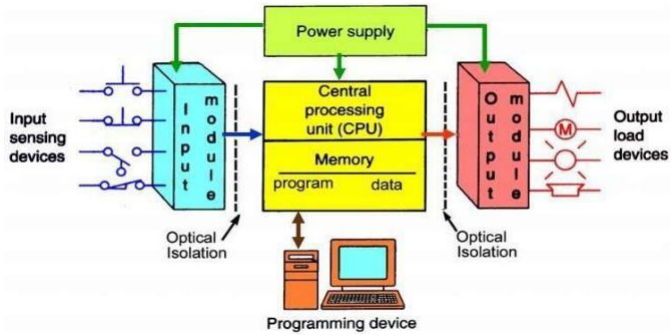
3.3 UVC Lamp:-

(11 V, 258 nm) It is used to disinfect the system And 258 nm is Perfect wavelength for the disinfection and it is prove by DRDO. UVC radiation is a known disinfectant for air, water, and nonporous surfaces. UVC radiation has effectively been used for decades to reduce the spread of bacteria, such as tuberculosis. For this reason, UVC lamps are often called "germicidal" lamps. UVC radiation is commonly used inside air ducts to disinfect the air. This is the safest way to employ UVC radiation because direct UVC exposure to human skin or eyes may cause injuries, and installation of UVC within an air duct is less likely to cause exposure to skin and eyes.

Photograph: UVC LAMP

3.4 PLC:-

PLC stands for Programmable Logic Controller. They are industrial computers used to control different electro-mechanical processes for use in manufacturing, plants, or other automation environments. The major advantage of a PLC over the conventional controllers its robust nature. It has high fidelity in most dynamic environments. PLC is reluctant to noise from the peripherals and hence is a reliable device for automation where accuracy and correctness is prominent. Another major advantage of a PLC is its ability to handle multiple input and output ports which processes analog as well as digital signals.Various relays needed to be incorporated in a given system in order to control its various parameters such as current or voltage for driving a motor. Thus in order to control a complete system multiple relays had to be used. It ultimately required lot of space and power because of bulky size of a relay due to its components. Also coordination between relays was a major issue because of their electromechanical operation.



3.5 SMPS:- (Switch Mode Power Supply):-

(24 V, 3Amp) A switched-mode power supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state. Switching power supplies have high efficiency and are widely used in a variety of electronic equipment, including computers and other sensitive equipment requiring stable and efficient power supply. A switched-mode power supply is also known as a switch-mode power supply or switching-mode power supply

3.6 Sensor Optical Proximity:-

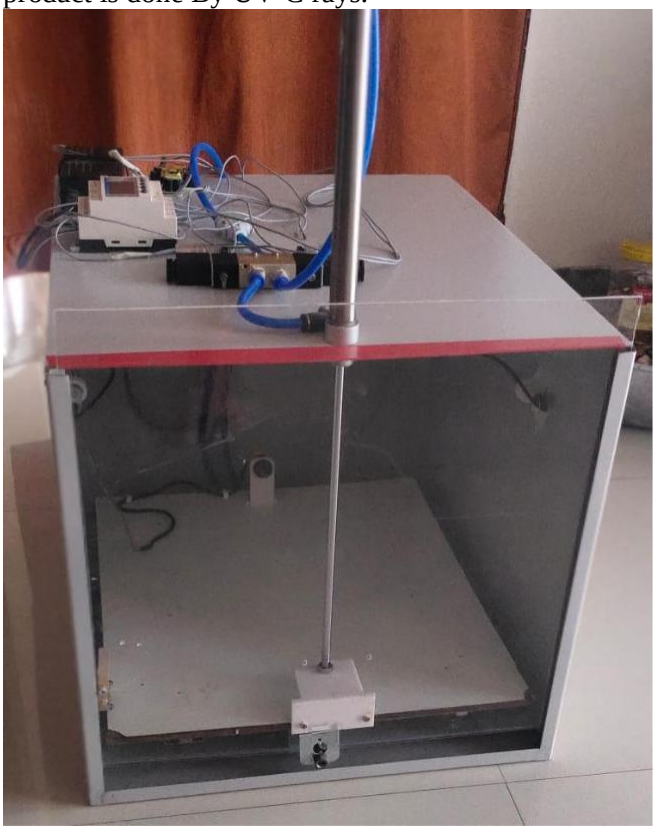
This sensor Are Used for automated system. The optical proximity sensor can be used to detect the position, so basically, they are position sensors.

Photograph: Optical Proximity Sensor

This is a type of sensor that can convert signals generated by light emission into electrical signals. This is also a contact-free position sensor and its sensing range is up to 10-15meters. The major part of an optical sensor is a light source which could be an LED and a detector. The optical proximity sensor can detect materials such as solid, liquid, powder, and opaque.The optical proximity sensor has an electronic part that would evaluate and amplify the detected signal. These sensors are widely used in automated systems because they are smaller in size. This device can detect the distance and presence of an object by using light.

3.7 MS Container:-

(18×18×22) inches this container is seal pack from every side and in this container the disinfection of product is done By UV-C rays.



4. CALCULATION:-

Pneumatic Cylinder A pneumatic cylinder is designed for converting pressure energy into useful work (motion). A double acting cylinder is operated by the reciprocal input of compressed air. When compressed air is applied to the rear port of the cylinder while the other side is open to the atmosphere, the cylinder starts to advance. To return the piston to its initial position the air supply has to be connected to the front port while the rear chamber of the cylinder has to be exhausted. The switching of air is done by means of a directional control valve.

First, we must gather some basic information about your pneumatic cylinder so we can calculate the air consumption:

- Piston Area (Bore x 3.1415)
- Rod Area (for double-acting cylinders)
- Stroke
- Cycles per minute

Calculating the air consumption for a single-acting cylinder is a rather easy calculation, but it is important to understand that the required air flow is dependent not only on the bore area and stroke, but also the cycle rate of the pneumatic cylinder.

The formula for the air consumption of a single-acting cylinder is as follows:

- A = Piston Area (Square Inches)
- S = Stroke (Inches)
- C = Cycles per Minute

Keep in mind that dwell times and cylinder sequence can affect the results when using this formula. n a double-acting cylinder, the retracting volume and extending volume differ by the displacement of the rod.The formula for the air consumption of a double-acting pneumatic cylinder is as follows:

- A = Piston Area (Square Inches)
- R= Rod Area (Square Inches)
- S = Stroke (Inches)
- C = Cycles per Minute

$$\dot{P}_1 = \frac{C_f R\sqrt{T}}{V_{01} + A_1\left(\frac{1}{2}L + x\right)}\left[\alpha_{in}\phi_{in_1}\bar{A}_{v1_{in}}P_s\dot{m}_r(P_s, \bar{P}_1) - \alpha_{ex}\phi_{ex_1}\bar{A}_{v1_{ex}}\bar{P}_1\dot{m}_r(\bar{P}_1, P_a)\right] - \alpha\frac{P_1A_1}{V_{01} + A_1(\frac{1}{2}L + x)}\dot{x}$$

and

$$\dot{P}_2 = \frac{C_f R\sqrt{T}}{V_{02} + A_2\left(\frac{1}{2}L + x\right)}\left[\alpha_{in}\phi_{in_1}\bar{A}_{v2_{in}}P_s\dot{m}_r(P_s, \bar{P}_2) - \alpha_{ex}\phi_{ex_2}\bar{A}_{v2_{ex}}\bar{P}_2\dot{m}_r(\bar{P}_2, P_a)\right] - \alpha\frac{P_2A_2}{V_{02} + A_2\left(\frac{1}{2}L + x\right)}\dot{x}$$

- R = 8.3144 L kPa/(K mol) is the ideal gas constant
- T is the temperature (oK)
- α, αi n, and αe x take values between 1 and k (heat

- specific index), depending on the actual heat transfer
- during the process; the recommended value for
- upstream/downstream α = 1.2, see [45]

What is force?

Law of Newton:

Force = Mass x Acceleration

F=m*a

F Force (Newton)

m Mass (Kg)

a Acceleration (m/s^2)

The acceleration on earth due to the gravity is **g = 9.81 m/s²** » 10 m/s^2. Example: On a box with a mass of 50 Kg acts a force of 490.5 N.

Cylinder piston force:-The theoretically available force is derived from the working pressure and the respective effective piston surface area. This available force is reduced by the proportion of system friction; generally, system friction amounts to between 5 and 10 % of the theoretically available force. The system friction is expressed through the efficiency factor.The theoretical piston force is calculated as the following:

Force = Effective piston area x operating pressure x Efficiency

A Effective piston area (m^2)

p Operation pressure (Pa)

h Efficiency factor

Cylinder diameter d1 = 22mm

Piston rod diameter d2 = 10mm

Pressure pe = 5 bar

Efficiency factor h = 0.85

1. Effective area for advance stroke:

Aa = $d1^2$ x p /4 = $(22\ mm)^2$ x p /4 = 275 mm^2 = 2.75 cm^2

2. Force for advance stroke:

Fa = p x Aa x h = 50 N/cm^2 x 0.275cm^2 x 0.85 = 11.6875 N

3. Effective area for return stroke:

Ar = ($d1^2$ x p/4) - ($d2^2$ x p/4) = $((22\ mm)^2$ x p/4) - $((10mm)^2$ x p/4) = 150mm^2 = 15cm^2

4. Force for return stroke

Fr = p x Ar x h = 50 N/cm^2 x 15 cm^2 x 0.35 = 26.2N

Note: A double acting cylinder has on its advance stroke a greater force than on its return stroke. This is due to different effective piston areas for. For the return stroke the area of the rod has to be subtracted form the area of the piston to get the effective area.

5. CONCLUSIONS:-

The compact UVC conveyor system developed can efficiently disinfect the It can be used to Disinfect: Files/ Paper, Currency, Air, Fruits, Vegetables, Coins, Surgical Utensils, Tablets, Laptops, Toys, Grocery and a variety of surfaces in Offices, Homes, Industry, Hospitals, Banks, and Shops. passing through the conveyor within a few seconds and is suitable for use in airports, railway and bus stations, hotels, commercial and private establishments for rapid disinfection UVC based disinfection systems are known for their rapid disinfection capability, and the disinfection process is dry and chemical-free. UVC irradiation at 254 nm is known for its germicidal properties where no chemical residues are left behind. UVC light, when irradiated on an infected surface, quickly disrupts the genetic material in the virus and thus inhibits its multiplication.

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