Article

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Development of sanitizing system

Desarrollo de un sistema higienizador

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Abstract

In accordance with the health emergency suffered at the international level, as a result of the pandemic generated by COVID-19, this research consists of the development of the design of a prototype of a technical full-body disinfection chamber to prevent the spread of COVID-19. 19, Through a research methodology carried out in the best way where it includes the implementation of a descriptive method based on the study and analysis of the existing bibliography, which is characterized by the collection of national and international background information, with the in order to generate a solid database as a guide, mainly focused on the explanation of the operating mechanisms and design methods of disinfection cabinets. At the same time, fulfilling the execution of a series of specific activities, which result in the first place the parameterization of all the elements, both mechanical and electromechanical, necessary for the chamber to be designed, as a second a modeling in Software Solidworks of the chamber of disinfection where it has the design of the electrical circuit of the chamber, design of the hydraulic system, the structure and the electromechanical accessories that the chamber must have.

Development, System, Saniting

Resumen

De acuerdo con la emergencia sanitaria sufrida a nivel internacional, producto de la pandemia generada por el COVID-19, La presente investigación consiste en el desarrollo del diseño de un prototipo de una cámara de desinfección de cuerpo completo tecnificada para prevenir el contagio del COVID-19. Por medio de una metodología de investigación realizada de la mejor manera, donde abarca la implementación de un método descriptivo fundamentado en el estudio y análisis de la bibliografía existente, la cual se caracteriza por la recopilación de información de antecedentes nacionales e internacionales, con el fin de generar una base de datos sólida como guía, principalmente centrada en la explicación de los mecanismos de funcionamiento y los métodos de diseño de cabinas de desinfección. A su vez, cumpliendo la ejecución de una serie de actividades específicas, que dan como resultado en primer lugar la parametrización de todos los elementos, tanto mecánicos como electromecánicos necesarios para la cámara a diseñar, como segundo un modelamiento en Software Solidworks de la cámara de desinfección donde este cuenta con el diseño del circuito eléctrico de la cámara, diseño del sistema hidráulico, la estructura y los accesorios electromecánicos con los que la cámara debe contar.

Desarrollo, Sistema, Higienizador

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Introduction

This article presents the development and study of a prototype of a sanitising system, which aims to contribute to the reduction of body contamination of viruses and bacteria, mainly the virus called SARS CoV 2 commonly known as COVID-19, which began in December 2019 in the city of Wuhan, China and subsequently the outbreak and contagions identified worldwide led us to two years of pandemic in which a new lifestyle was generated performing all activities both school, work and daily life from home. However, not everyone and not all activities could be carried out in this way, there were exceptions that required staff to attend and move from one point to another, putting themselves and those around them at risk.

Having safe spaces in which there is a sanitised environment is the key to recovering and maintaining the lifestyle that existed before the pandemic, just as the population learned to wash their hands in the correct way, it became natural to see people using masks and masks to protect themselves from the virus, disinfectants were used more frequently in work areas or those areas where people spent more time, in the same way we seek to offer a practical and adaptable solution to everyday life.

An equipment capable of generating a cloud of sanitiser which is not harmful to the user and provides 99% disinfection, so that each and every person who passes through the area in which this equipment is located will be less risk of contagion for each and every one of those who are in that area.

Problem

Countries worldwide are affected by a pandemic, known as SARS-Cov 2 (COVID 19), whose ravages are evident in that health systems are overwhelmed by the high demand for care of patients infected by this virus, likewise the education system was affected by this virus resulting in 2 years of quarantine in which school activities were conducted virtually, however with the vaccine for the virus is expected to resume activities in a manner close to that which had before suffering the pandemic.

On-site activities on university premises can only continue if students, teachers and administrative staff take the necessary precautions and care inside and outside the premises. However, outside the facilities, the care that we find is minimal and inside the facilities may not cover the flow in and out of the entire student community.

Hypothesis

The development of a sanitising system that can be placed in the doors of offices and rooms that are able to spread a sanitiser in a safe and economical way, decreasing with this action the level of viruses and bacteria that could contain each person that crosses this frame.

Objective

To develop a sanitising system to be placed in the entrance doors to offices and/or classrooms of building K of the Universidad Tecnológica Fidel Velázquez to minimise the viral load in the people who enter the building.

Theoretical framework

The creation and implementation of this system requires the analysis of different factors such as the number of people who pass through the facilities on a daily basis, the capacity of the container necessary to maintain a constant flow of liquid. The pressure necessary to avoid humidity in those who pass through the system, therefore, it is necessary to take into consideration the following aspects.

Fluid pressure is the force per unit area exerted by a fluid on the element (pipe) that contains it.

Vaporisation occurs because molecules are continuously projected across the surface of the liquid, due to their thermal energy or vibration.

Frictional energy loss, The viscosity of fluids generates shear stresses when they are in motion.

Friction losses in injection systems and hoses, Similar to the case of friction in pipes, losses in injection systems or fire protection hoses are directly proportional to the length.

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Principle of operation of hydraulic pumps, Hydraulic control valves are operated by two important component parts and by a basic principle of physics. The hydraulic actuator (diaphragm or piston) and the plug are two elements that are in contact with both upstream and downstream pressures, generating forces on them.

Methodology to be developed

Through the research, the bibliographic review of different sources is established with the aim of knowing the types of disinfection booths currently implemented to mitigate the global pandemic of COVID-19 that has affected 185 countries with a total and has seriously damaged the economy. The booths allow a degree of control to be maintained over entry to certain areas, which is why the cleaning and disinfection of people is so important for the prevention, control and eradication of the virus. This is an ideal system for: Public institutions, Medical centres, Event venues, Business and commercial centres, Markets and supermarkets.

Phases of the research

Phase 1. Bibliographic review

Phase 2. Characterise the necessary technical parameters that a disinfection chamber should have, taking into account the type of local population.

- Activity 1. Determine the structural measures required for the chamber.
- Activity 2. Determine the necessary hydraulic equipment used in these facilities.
- Activity 3. Determine materials to be used for the structure of the equipment.
- Activity 4. Determine accessories required for the equipment.

Phase 3. Develop the modelling of the disinfection chamber, its structure and the electromechanical accessories it should have.

- Activity 1. Make the mechanical model of the chamber structure.
- Activity 2. Design the electrical circuit of the chamber.
- Activity 3. Design the hydraulic system of the disinfection chamber.
- Activity 4. Assemble all the cabin systems.

Design the necessary documentation for the start-up of the disinfection chamber.

- Activity 1. Draw up the required drawings of the structure.
- Activity 2. Draw up operating manuals and technical sheets for the equipment.

Elaborate an economic proposal for the equipment

For the development of this objective, it is necessary to establish the parameters observed in the investigations of disinfection processes, taking into account the norms and standards implemented. From different investigations it is intended to know the course of the study, the factors that were taken into account and the results that were achieved, whether advantages or disadvantages. And through this information, the requirements that are needed to carry out the execution of the present project are made. The following is a description of the investigation of booths in different cities of the country.

The process that was carried out was primarily to design and make the booths in software in order to define what electronic devices they were going to use (sensors or buttons) but they decided to make them automatic so that people do not need to come into contact with the booth, they only need to enter, inject the product and leave. After the design, they looked for the materials to manufacture them and started the construction process.

The cabins are made of aluminium structures. The walls are made of PVC bank. They have an automation system and a proximity sensor so that when the person enters, they just put their hand close to the sensor, about 3-4 cm away, and automatically receive the spray or nebulisation of the product, which is a mixture of alcohol (70%), hydrogen peroxide (5%) and drinking water (25%).

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The booths have three atomisers or nebulisers in order to cover the whole body of the person, from head to toe. The injection time is 6 to 8 seconds. They also indicate a number of advantages and disadvantages characterised by:

Advantages

- It is designed so that the person does not come out completely wet.
- Does not stain.
- No risk of causing allergies.
- Disadvantages.
- People do not come out 100% disinfected.

The mechanism of operation of the sanitising arch is by means of a micro-spraying system that prevents viruses and bacteria.

To start with the equipment it will be necessary to take the measurements of the area where the equipment will be placed, taking into account the height, the width of the entrance frame, in this way there will be no problems if the equipment is not custom-made.

Once the information is available, we can start with the prototype of the equipment, in which the main functioning elements will be the hoses, nebulisers, sensors, etc., which will be in charge of spreading the liquid in an easy and non-invasive way.

The solution is constituted as follows:

- Alcohol 70%.
- Oxygenated water 5%.
- Potable water 25%.

Construction process.

Fabrication of the structure.

Implementation of the piping.

Lifting of the PVC structure.

Implementation of sensory equipment.

Connection of the electrical system.

Assembly of the automated system.

Connecting the elements such as hoses and nebulisers in such a way that the necessary pressure of the equipment is maintained in order to obtain the liquid to be sprayed as a gas on the people passing through this area.

Establish a connection between the spraying equipment and the electronic board that will be connected to the ultrasonic sensor which will send the signal to start the spraying process.

Once the connections of the equipment have been made, it will be necessary to implement the power supply for the operation of the equipment. Once the operation of the equipment has been verified, it is possible to move on to the installation and testing of the equipment.

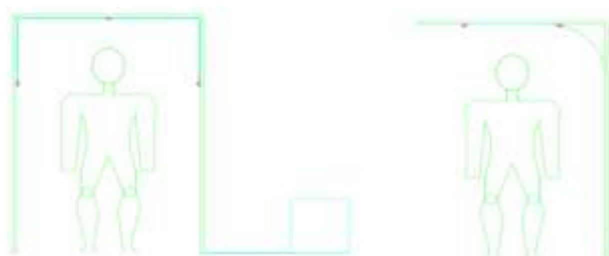

Figure 1 Door frame

Establish an average number of people who will pass through the sanitising frame per day, thus obtaining the amount of sanitising liquid needed for the equipment per day.

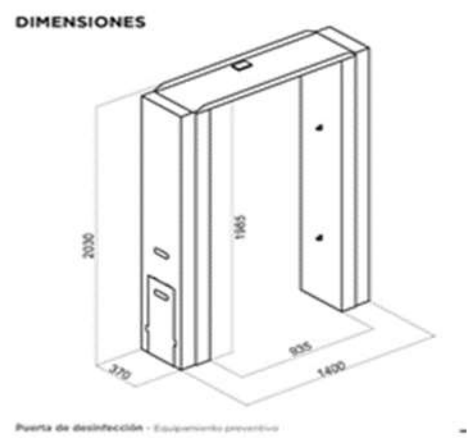

Figure 2 Door frame design

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Results

Structural models of the disinfection chamber will be elaborated taking into account the material to be used and a simulation of the structure to define maximum stresses. Also, using other tools, the electrical and hydraulic drawings of the equipment will be drawn up.

Proposed model

The model was tested according to the characteristics and the environment in which the installation was to be carried out. The results were as follows:

The sanitising system does not have enough space to include its storage tank.

The distance between the sprinklers and the proximity sensor is too short, so the liquid would interfere and even damage the sensor.

In the case of not including a storage tank for each system, a piping system should be installed on the premises.

The infrastructure is not in place to make the piped connections, a person would be needed to maintain each and every one of the installed systems.

The system would have to be refilled and monitored at certain times to prevent the system from running out of liquid.

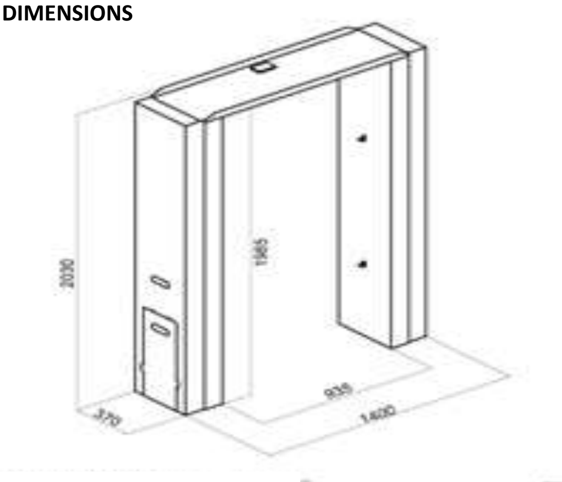
The cost of this system would be too high with current technology.

Alternative

Cabin disinfection system.

No additional piping would need to be installed in the facility, the sensor is protected and performing its function, the storage tank can be of larger capacity and one can be installed per building, which would reduce the investment cost. Maintenance can be carried out by one person. It fulfils the function of disinfecting everyone who passes through it.

DIMENSIONS



DISINFECTION DOOR

BILL OF MATERIALS FORAUTOMATIC SPRINKLER						
TOTAL	MATERIAL					COST
						.
1	BOMM MICRO DIAPHRAGM PUMP 12V 3A 60W					
3	SPRINKLERS AND NOZZLE					KIT 1700 MX
	SUPPORT (STRUCTURE WHERE THE HOSES AND SPRAYERS WIL BE)					
1	HOSE d=4mm, 5m.					
1	FILTER PP COTTON					
1	ULTRASONIC SENSOR					60 MX
1	CONTROL BOARD WITH TIMER					78MX
1	CABLE					
					APPROX	1838MX

Table 1 List of materials

Funding

The development of this prototype was self-funded. A breakdown of costs is shown below.

Conclusions

This prevention system complements the sanitary measures recommended by the health authorities and helps to mitigate the risk of infection of diseases caused by viruses and bacteria. The design of the optimal cabin was based on the revision of transcendental points such as the position and ignition of the sprinklers, the decontamination process at the entrance of the cabin and the adequate selection of materials for its basic structure. In this way, the health of teachers, students or any other person entering the facilities can be monitored, prevented and controlled.

In accordance with the research carried out, the characterisation of the necessary technical parameters that a disinfection chamber must have, taking into account the type of local population, is concluded. The results obtained allow the evaluation of a series of investigations which were a guide for the authors in relation to the types of materials used, nominal measurements, among other factors.

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Secondly, the disinfection chamber, its structure and electromechanical accessories were modelled using software. The design was distributed by means of geometrical drawings which show the nominal measurements of the structure.

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