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# Design of Automated Walk-Through Sanitizing Booth: A Preventive Measure Against Re-Emergence and Spread of COVID-19 Related Diseases

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## Abstract:

Considering the alarming rate with which the Corona-virus spread around the globe and its devastating effect on the economic, social and psychological well-being of the people worldwide, it is necessary to take measures that may prevent such re-occurrence in the nearest future. The impact of the virus was quite severe, indicating the importance of taking precautions. Realizing the gravity of the situation, governments all over the world, imposed a nationwide lockdown early on, which helped to decrease the possibility of community transmission. However, even after the lockdown, the risk of cross-contamination continues to be a significant concern. This risk was particularly high with asymptomatic individuals who can unknowingly spread the virus without exhibiting serious symptoms. Even now, that clinical trials have demonstrated the effectiveness of some vaccines in reducing mild, moderate, and severe cases of COVID-19. It is necessary to set up preventive measures in combating the occurrence or re-emergence of such pandemic Corona-virus related diseases in the nearest future. A full body sanitizing machine which can be easily constructed was designed in this work. This machine takes the form of a door and tunnel structure, with two sides enclosed by Chaka Plates and two sides open for entry and exit purposes. When a person enters the tunnel, a sensor located at the top center detects its presence and activates the motor, which initiates the entire system. A total of 8-10 sprayers are activated and spray the person's body, automatically stopping after 4 seconds. This machine is capable of sanitizing fifteen people per minute. The discharged fluid and the temperatures of ten individual samples were tested and analyzed in order to ensure that the booth is working effectively. The tested samples confirmed that the tested samples have not been previously infected with the COVID-19 virus.

**Keywords:** *Economic hardship, community transmission, corona-virus, asymptomatic individuals, global development.*

## Introduction

COVID-19 disease is caused by a novel corona-virus that emerged in Wuhan, China in late December 2019, After the outbreak, China took swift action by imposing a strict lockdown in Wuhan city, which involved disinfecting all public areas that includes rail stations, hospitals, bus stops, food markets among others (Hussain, et al., 2020; WHO, 2019). The Chinese government utilized various approaches using local and advanced technologies including walk-behind spraying systems, unmanned aerial spraying systems, to disinfect these areas (El Majid, et al., 2020; Tian, et al., 2020). As the virus spread globally, individuals from other countries who had been in China began returning to their home countries, resulting in a lack of adequate arrangements at airports. This contributed to the rapid transmission of the virus to other countries, despite infected individuals not showing symptoms initially (Jones, 2017; Iqbal, et al., 2020; Shi, et al., 2020).

COVID-19 poses significant challenges due to its ability to survive on different surfaces for varying periods, ranging from hours to days, and the absence of symptoms during the initial 2 to 14 days after exposure (Hussain, et al., 2020; Thakur, et al., 2020). These factors facilitated the rapid global spread of the disease, affecting numerous countries within a short span of time. With its reach spanning over 213 countries and territories across the world, the pandemic had a profound impact on the worldwide populace (Hussain, et al., 2020; You, et al., 2020; Pinjarkar, 2020). Governments worldwide implemented stringent measures to prevent community transmission. The measures include lockdowns, home quarantine, and preventive measures such as regular handwashing, wearing of face masks, and avoiding physical contact. Some experts predicted that if a vaccine were not developed within the next 6 to 12 months, COVID-19 could infect over 100 million people worldwide (WHO, 2019). The lockdown measures implemented in response to the pandemic had a detrimental effect on global development and industrial activities, leading to significant economic losses of over 17 trillion dollars and the potential for increased poverty and inflation, affecting more than 1 billion people worldwide (WHO, 2019; Pinjarkar, 2020).

The World Health Organization (WHO) in May, 2020 issued some guidelines on how to use disinfectant sprays to sanitize contaminated surfaces with pathogens. WHO further expressed the need for direct contact with recommended sprays is an effective method of disinfection, as this enables the germicidal properties of the disinfectants. To ensure the successful eradication of microorganisms, it is crucial to correctly dilute and apply the disinfectants for the appropriate duration. WHO also recommended following the manufacturer's instructions when preparing disinfectant solutions, including the correct spraying volume, concentration, and contact time. Incorrect concentration levels can reduce the effectiveness of the disinfectant (Hussain, et al., 2020). Moreover, using a high concentration of disinfectant can pose risks such as increased chemical exposure and potential damage to surfaces (El Majid, et al., 2020). As a result, it is critical to apply the optimal and suggested disinfectant concentration to adequately disinfect entrance and exit areas.

Though, clinical trials have shown the effectiveness of some vaccines in reducing mild, moderate, and severe cases of the disease, it is necessary to take measures that may prevent such re-occurrence in the nearest future. A full body sanitizing machine which can be easily constructed was designed in this work. This machine takes the form of a door and tunnel structure, with two sides enclosed by Chaka Plates and two sides open for entry and exit purposes.

## Materials and Methodology

### Study Design

The Walkthrough Booth design incorporates several key parameters (El Majid, et al., 2020). These include a dustbin for discarding used or infected masks and tissues, a touchless hand sanitizer dispenser that dispenses sanitizer when a person's hand is sensed, ON/OFF sensors attached to each shower to activate or deactivate the shower when a person approaches or moves away, mist-form disinfectant spray from the showers (Tian, et al., 2020), a ultraviolet (UV) disinfectant sensor has been proposed for the purpose of disinfecting metallic objects and luggage (Jones, 2017). Additionally, an RGB thermal camera was used to monitor body temperature upon entry. If an individual's body temperature exceeds the permissible limit, an alarm will sound, prompting the necessary measures to be taken.

Furthermore, the showers will remain inactive unless a person is in contact with the sensor. If an individual's body temperature is outside the acceptable range (36.1 to 37.5 °C), which can be adjusted as required (Jones, 2017), an alarm will also sound. The system is managed by a control panel which regulates all sensors, showers, power supply, and spraying functions. An electric motor is connected to each shower to provide pressurized disinfectant spray when activated. A spraying tank ensures a continuous supply of disinfectant spray to the showers. Overall, the Walkthrough Booth design includes these features to facilitate a comprehensive disinfection process, incorporating temperature screening, hand sanitization, and mist-form disinfectant showers, while also ensuring the safe disposal of used items and disinfecting luggage or metal materials using UV technology.

## The Construction

The walkthrough booth was constructed using chaka plate, which is a type of metal that is 1.5 mm thick as in Figures 1(a) and 1(b). The materials were procured from suppliers located in Ekiti and Lagos states of Nigeria. The medical instrument supplier based in Lagos provided the mechanism used in the booth. The rectangular structure of the booth was assembled by joining the metal plates and pipes together using the riveting method. The final dimensions of the booth were 300 mm by 100 mm. They were assembled into a rectangular shape with dimensions of 300 mm by 100 mm. The booth was designed with openings in the front and back to allow for unrestricted passage of users. The dimensions of the booth are as follows: 1000 mm by 2135 mm by 1.5 mm.

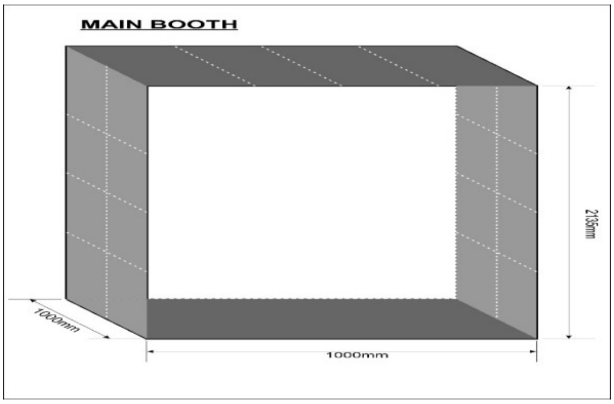


Figure 1(a). Pictorial Sketch Booth Frame

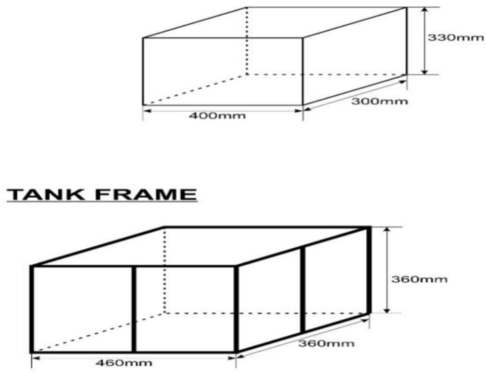


Figure 1(b). Pictorial Sketch Chemical Tank

## Electrical circuitry

The production of the walk-through booth involves the construction of the walk-through frame as well as the incorporation of various other components. These additional parts include the relay, delay timer, SMPS (Switch Mode Power Supply), NPN Infrared Sensor, and a 12 V DC high-pressure pump as shown in Figure 2.

## Recommended Chemicals

Benzalkonium (BKC) is the recommended chemical for sanitization purposes. It has been proved that a weight concentration of 0.02-0.05% of BKC does not have any adverse effects on normal skin flora while thoroughly destroying standard microbes. In order to ensure proper sanitization of personnel walking through the mist tunnel, it is recommended to use a sodium hypochlorite solution with a weight concentration of 0.02-0.05% (equivalent to 200 to 500 ppm), following standard safety precautions (Hussain, et al., 2020; WHO, 2019).

However, it is observed that many people are not using the recommended concentrations scientifically. Some use higher concentrations, which can be unsafe, while others dilute it too much, rendering it ineffective. Individuals with a high risk of exposure, such as health workers, police officers, and municipal employees, should use a solution with a 0.05% weight concentration. A 0.02% weight concentration solution is advised for persons working in standard office environments.

The disinfection tunnel constructed by ICT Mumbai offers a benzalkonium chloride concentration of 30 parts per million (ppm). Additionally, scientists advocate wearing face shields or safety goggles during the walkthrough procedure for extra protection.

Delay Timer

Switch Mode Power Supply


NPN Infrared Sensor


12 V Dc High Pressure Pump

High Temperature Nozzle

Infrared Thermometer

**Figure 2. Electrical Materials for the Booth Production**

## Coupling

The coupling process involved using a 0.5mm chaka plate for joining the plates and pipes together. The metal joining was achieved through the riveting method. To accommodate the electrical fittings, a casement with dimensions of 100mm by 50mm was installed at the top. In order to make the booth mobile, two metal legs were attached during the coupling process.

The electrical fittings were properly installed and connected using 1.5mm electrical wire. The thermometer used in the setup has a response time of 0.50 seconds when detecting an image. It is designed for automatic measurement, with a measurement distance range of 5cm to 10cm.

The infrared measuring range of the thermometer spans from 0 to approximately 50°C.

## Results and Discussion

Table 1 displays the temperature measurements and the discharge volume of the fluid for ten different users:

**Table 1. Temperature of the Ten Users**

| SAMPLES | Temperature (°C) | Volume (ML) |
|---|---|---|
| A | 36.5 | 84.0 |
| B | 36.4 | 83.1 |
| C | 36.2 | 83.8 |
| D | 35.8 | 82.7 |
| E | 35.6 | 83.0 |
| F | 37.0 | 83.1 |
| G | 36.1 | 83.2 |
| H | 36.3 | 83.3 |
| I | 36.0 | 83.2 |
| J | 36.7 | 83.1 |

The recorded temperature outcomes were observed to fall within the body normal range for a healthy person (35-37°C). Hence, there would be no cause for alarm or referral for COVID-19 testing.

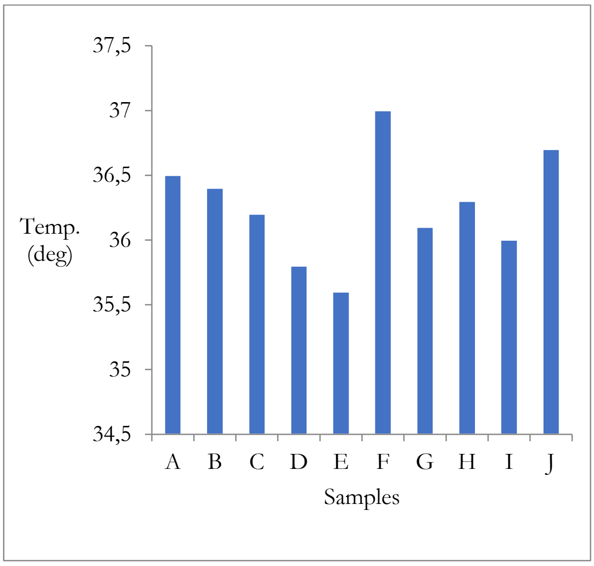


**Figure 3. Graph of the Temperature of Users**

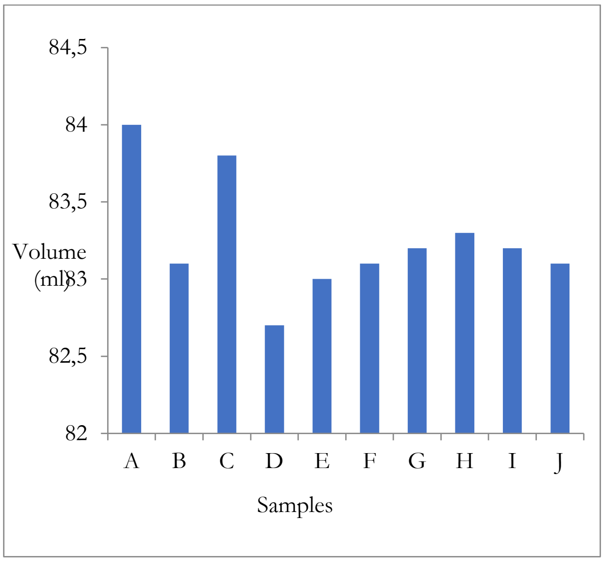


**Figure 4. Graph of the Volume of Fluid Discharged per Sample**

## Conclusion

The research demonstrates a rapid and effective approach to mitigating the spread of COVID-19. The fabrication methods employed in constructing the sanitizing walkthrough booth demonstrate that domestically produced booths can meet or even surpass the standards of imported booths, resulting in enhanced effectiveness. activated. A spraying tank ensures a continuous supply of disinfectant spray to the showers. Overall, the Walkthrough Booth design includes these features to facilitate a comprehensive disinfection process, incorporating temperature screening, hand sanitization, and mist-form disinfectant showers, while also ensuring the safe disposal of used items and disinfecting luggage or metal materials using UV technology.

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