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DEVELOPMENT OF AUTONOMOUS TEMPERATURE SCREENING AND SANITIZATION BOOTH TO REDUCE THE SPREAD OF COVID-19 VIRUS IN PUBLIC PLACES

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Abstract: This paper describes a sturdy autonomous temperature screening and sanitization booth which measures the temperature and then disinfects external surfaces like clothes and open body sections of a user from COVID-19 virus in public places such as educational institutes, offices, airports and leisure places. Although after the widespread of corona virus many disinfection tunnels were launched in the market but these tunnels were quiet basic and were automated to a certain extent that is a motion sensor was used to detect an incoming person which in turn activates the machine for a specific period of time. In order to make this booth highly efficient and effective, it has been divided into two separate sections via a sliding door which also operates autonomously. The first section of the booth is known as temperature screening section in which the temperature of the user is measured while the second section is used for the sanitization purpose. The disinfectant solution used is a dilute solution of the approved chemicals by the government. Both the sections work autonomously with a help of microcontroller (Arduino).This proposed booth is developed industry-academia collaboration jointly by StarForce Engineering Co. and the Mechanical Department of Gulzar Group Of Institutes. The booth is referred to as the 'Autonomous Temperature Screening and Sanitization Booth' (ATSSB).

Index Terms: Autonomous booth, Covid-19, Sanitization booth, Sliding door, Temperature screening.

1. Introduction

Corona virus disease 2019 (COVID-19) is a contagious disease caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). COVID-19 transmits when people breathe in air contaminated by droplets and small airborne particles containing the virus. The risk of breathing these in is highest when people are in close proximity, but they can be inhaled over longer distances, particularly indoors. Transmission can also occur if splashed or sprayed with contaminated fluids in the eyes, nose or mouth, and, rarely, via contaminated surfaces. People remain contagious for up to 20 days, and can spread the virus even if they do not develop symptoms.

At present there are 7 vaccines which are approved by the World Health Organization (WHO) that is Moderna: mRNA-1273, Pfizer/BioNTech: BNT162b2, Janssen (Johnson & Johnson): Ad26.COV2.S, Oxford/AstraZeneca: AZD1222, Serum Institute of India: Covishield (Oxford/AstraZeneca formulation), Sinopharm (Beijing): BBIBP-CorV (Vero Cells), Sinovac: CoronaVac, but because of

the continuously changing 'variants' of the virus (a virus with one or several new mutations to the original virus) these vaccines are not 100% effective, currently a new variant of COVID-19 named as delta variant is spreading at an alarming rate and some of the studies suggest that these vaccine are not that much effective against the delta variant. However, they still can reduce the impact of this variant up to some extent. Also a massive UK study of COVID-19 cases shows that people who are jabbed have good immunity at first, but quickly become more vulnerable to the fast-spreading Delta variant. So, vaccination is considered as one of the preventive measure rather than a perfect solution to tackle COVID-19.

As many studies has shown that this virus is active for up to 3 hours in aerosols, up to four hours on copper surfaces, up to three days on steel and plastic surfaces, and up to twenty-four hours on cardboard surfaces (Van Doremalen et al. 2020). This shows that without proper disinfection, the virus can spread dramatically through contact surfaces and air. Effective surface and air disinfection can ensure an early containment and prevention of further viral spread. For the disinfection purpose, 0.1% of sodium hypochlorite solution is found to be quite effective and safe as it kills the virus under a minute and is safe to be sprayed on human body.

While other preventive measures which are suggested by WHO are to stay at least 1 meter away from others, wear a mask, clean surfaces regularly with standard disinfectants, frequently clean your hands with soap and water, or with an alcohol-based hand rub, cover your coughs and sneezes with a bent elbow or tissue.

For reducing the COVID-19 virus outbreak, when the economy limps back to normalcy a sturdy disinfection system along with temperature sensing system is required to break the chain of the virus from spreading in public places. An autonomous disinfection system can perform contactless disinfection of the exterior surfaces to arrest further infection if one gets contaminated while moving/ working, and it will be an effective deterrence to the spread of infection. While the autonomous temperature screening system records the accurate temperature of an incoming person. The ICAR-Central Arid Zone Research Institute, Jodhpur, Rajasthan (2020) developed a self Disinfection Walk-In Tunnel. The structure of the tunnel is fabricated using angels of iron and the structure is cladded with UV established polythene sheets fixed using aluminum profiles. Total 9 foggers are fixed along the side walls and roof for creating a uniform misting condition inside the chamber. The sanitization solution is pumped through a filter by a half HP centrifugal pump.

The proposed temperature sensing and disinfection booth by the Mechanical Department of Gulzar Group Of Institutes and StarForce Engineering Co. is named as the 'Autonomous Temperature Screening and Sanitization Booth' (ATSSB), which has two sections separated by an automated sliding door. The first section is known as the temperature screening section where the temperature of user is recorded and if the temperature of the individual is within the range recommended by WHO, then the automated sliding door gets unlocked and the door is retracted, so that the user can proceed towards the sanitization section of the booth. In the sanitization chamber a fine mist of disinfectant solution is sprayed over the user via various nozzles placed at different position inside the booth. All these operations are carried by a microcontroller named 'Arduino', the operations are performed according to the code which is uploaded in it; because of the microcontroller this booth is fully autonomous which means that it does not require any human assistance to perform its function.

2. EXPERIMENTATION AND METHODOLOGY

2.1 RAW MATRIAL REQUIRED:-

Raw Material/Electronic Components Required

Serial No.	Name of the raw material/electronic component	Quantity
1.	1.5*1.5 (3mm thick) Ms Angle	8 length (1length = 18feet)
2.	M3 Nut and Bolts with Washer	30pcs
3.	M16 Thread Rod with Nut	1(2feet 3 inch long)
4.	Rods (12 mm in diameter)	2(2feet long)
5.	½ inch steel plate	3pcs
6.	Ball bearings(for 12mm Rod)	2pcs
7.	5V 1 Ampere Power supply	2pcs
8.	Linear ball bearings (for 12 mm Rod)	2pcs
9.	(12mm diameter) shaft	1(1feet long)

10.	C Channel Aluminum frame	1(4feet in length)
11.	C Channel Sliding door roller set	1 set
12.	175 GPD Motor with its 24V dc power supply	1pcs
13.	PVC plastic pipe	10 feet in length
14.	High pressure Misting nozzles	6pcs
15.	Single phase 900 RPM AC Motors	2pcs
16.	Plastic T joints, elbows	10pcs each
17.	Gears	2pcs
18	Chain	10 feet long
19.	5mm ply wood	2 Sheet
20.	Flex sheets	According to size of booth
21.	Arduino microcontroller	1pcs
22.	Ultrasonic sensor HC-SR04	2pcs
23.	MLX 90614 Infra-Red Temperature sensor	1pcs
24.	20*4 LCD Display	1pcs
25.	12V DC Solenoid Lock	1pcs
26.	5V Relay module	2pcs
27.	5V H Bridge Relay Module	1pcs
28.	12V H Bridge Relay Module	1pcs
29.	Pedal Switch	2pcs
30.	12V 1 Ampere Power supply	1pcs
31.	Jumper cables	40pcs
32.	PCB Boards	5pcs
33.	Ribbon wire	15 feet long
34.	Zip ties	20pcs
35.	Solution Storage tank	1 pcs
36.	IR Proximity Sensor Module	2pcs

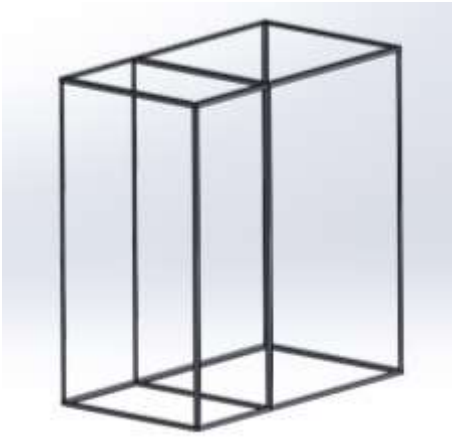
2.2 ***DESIGN OF THE BOOTH:-***

i. Steel Structure/Frame:-

The Steel Structure/Frame is made up of mild steel angles. The dimension of angle is 1.5*1.5(3mm thick)
The angles used in bottom and the top of the structure are welded using electric arc welding, further the angles which are used for height of the structure are bolted to the bottom and top of structure, the bolts are used to make the frame portable.

No. of Angles used with their lengths

Serial No.	Length of the angles used	No. of pieces
1.	7.5feet (to provide height to the structure)	6
2.	7 feet (to provide length to the structure)	4
3.	4 feet (to provide width to the structure)	6



Assembly of the Steel Structure in Solid Works

Assembly of Sensor Mechanism in Solid Works

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For the automated temperature screening i.e. machine operated temperature screening, a mechanism with which the sensor can move vertically according to the height of a person or his/her forehead is required. For this purpose a threaded rod of 16 mm in diameter is used, the threaded rod is rotated with the help of a 12V DC Gear motor. The Nut of that threaded rod is fixed to the sensor plate. Hence when the Rod is rotated the Sensor module moves along the vertical axis with the Nut which is welded with it. The range of the sensor module which can be moved vertically is from 4feet3inches to 6feet 3inches (2feet approximately). When the ac moter is powered with the correct polarity the rotation of the motor is clockwise, hence the sensor module moves upwards, and when the polarity is reversed the rotation of the motor becomes anti clockwise, thus the sensor module moves downwards.

Material used for making Sensor Mechanism

Serial No.	Name Of Component	Quantity
1.	M16 Thread Rod with Nut	1(2 feet 3 inches in length)
2.	(12mm diameter) Shaft/Rod	2
3.	½ inch steel plate	2(180*100mm) 1(180*102.7mm)
4.	Ball bearings (for 12 mm diameter Rod)	2
5.	linear ball bearings (for 12 mm Rod)	2

Fitting of sensor mechanism in the steel structure is displayed in form of Assembly in Solid Works.

iii.

A Sliding door is used as a partition between the Temperature Screening area and the sanitization booth area. The sliding door is also automated; it opens automatically when the temperature of the person who scanned his/her temperature in the temperature screening area is in the given range. If not the door remains closed. There is a lock

behind the door which remains locked until the temperature is in the recommended range. If a person even tries to enter the door without Temperature screening the door remains locked and the person cannot enter.

The mechanism which is used to make this sliding door an automated one is the chain drive. The door body is welded with the chain such that when the motor rotates and the gear starts to rotate the chain, the door will also moves in that direction of the rotation. The timing of the motors is set according to the door opening and closing time in the microcontroller.

Parts/Material required for automated sliding door

Serial No.	Name of the Parts/Materials	Quantity
1.	1.5*1.5 (3mm thick) steel angles	2(2feet long) 2(7feet 3 inches long)
2.	C Channel Aluminum frame	1 (3feet 11 inches)
3.	C Channel Sliding Roller set	1
4.	5mm ply wood	1 sheet
5.	gears	2
6.	chain	10 feet
7.	Pillow Bearing (for 15 mm shaft)	2pcs
8.	17 mm diameter shaft	1pcs
9.	12 V Dc Gear Motor	1pcs
10.	Screws	10pcs

Sliding Door fitted in the steel structure and sensor mechanism Assembly in solid works

3.1 WORKING:-

First of all when an individual enters the booth, he/she enters from the temperature screening section, here the person should adjust the temperature sensing unit according to his height which means the sensor should be pointed towards his forehead (recommended to get the accurate readings), this can be done by using the pedal switches provided at the bottom. Once the sensor is at the right place the person should follow the instructions which are displayed on the LCD screen, if the individual is too far or too close to the sensor the screen will display accordingly and will guide the person to maintain a certain distance from the sensor so that it can record the precise temperature reading. After few seconds the screen will display the temperature of the user and if the

temperature is in the normal range which is recommended by the WHO then the sliding door will get unlocked and will automatically be opened, in this time frame the person is allowed to move towards the next section which is the sanitization chamber (even if the person does not enter the sanitization chamber within 15 seconds, the sliding door will get automatically closed and will be locked) and if the temperature of the person is higher than the normal range the LCD display will show that 'Your temperature is High and you are not allowed' with this the sliding door remains locked and the person is unable to enter the sanitization section of the booth.

Once the user completes the first step that is the temperature screening, he is allowed to enter the sanitization chamber via the sliding door, in the sanitization chamber a fine mist of disinfectant solution (0.1% sodium hypochlorite solution) is sprayed via the misting nozzles with the help of a 175 GPD motor pump over the person for a period of 7-10 seconds. After the Sanitization process is completed the person can leave the booth free from external viruses and bacteria's.

4. RESULT AND DISCUSSION

After the fabrication of the machine, some working and performing tests of the machine were taken, to check the proper functioning of machine without any problem. So the following steps were observed as a result: -

1. When the person enters the booth, he/she will find the temperature sensing unit in front of them they have to adjust the temperature sensor according to his/her height so that the temperature sensor is facing towards the centre of their forehead, the adjustment can be made by the pedals switches provided at the bottom of machine.

Overview of the Booth

Person Adjusting the Sensor Unit according to his height using the foot pedals provided down there, So that the temperature sensor is pointing towards his forehead.

As the person is standing far from the Sensor unit the LCD Display Shows "COME CLOSER"

2. If the person is standing too far from the temperature sensor, then the LCD display show "COME CLOSER" or if the person is too near the sensor, then the LCD display show "GO FAR".
3. When the person is standing correctly i.e. he/she is maintaining proper distance from the sensor, then the LCD display show "HOLD STEADY".

As the person is standing to close to the Sensor unit the LCD Display Shows "GO FAR"

As the Person is standing correctly, the LCD Display Shows "HOLD STEADY"

Non Contact thermometer (MLX90614)

4. The temperature of the person standing in front of the machine will be sensed by a non contact thermometer (MLX 90614).
5. The coding of the Arduino is done as such that the temperature sensor senses the temperature of the person for 2 seconds, in this time frame the sensor has sensed no. of readings, but as a single result it will take the average of all those reading which were taken in that period of time.
6. If the Temperature of the person is higher than the Range which is set in the microcontroller, then the LCD display show "SORRY!" and then "NOT ALLOWED".
7. As the Temperature was high the door is remain closed and the system restarts its process from (1.).
8. If the temperature of the person is in the Range, then the LCD display show "WELCOME" with this the door to the sanitization booth gets unlocked first and after delay of 1 sec the door starts to Open.

As the temperature of the person is in the Range the LCD Display Shows "WELCOME" with the temperature "Temp is _____ you can go"

Person entered to the Sanitization Area of the booth after the door is unlocked and opened when the temperature of the person is in the Range during previous step

Sanitization process is taking place where a fine mist of the Disinfectant Solution is sprayed over the person

9. The Door remains open for the time period of 10 seconds, in this time the person has to enter the door, if not then the door is closed automatically and gets locked.
10. After the person enters the door and the door gets locked the sanitization process begins and it continues for 5 seconds, during these 5 seconds a fine mist of disinfectant solution is sprayed over the person via misting nozzles, So that if he/she has any harmful micro-organisms/bacteria over their clothes/body, with this spray it will ensure that they are eliminated.
11. After the process is completed the code resets and the process begin from step (1.)

5. CONCLUSION

This paper discusses the design and development of The Autonomous Temperature Screening and Sanitization Booth.

It was ensured in the machine that the person with recommend value of body temperature was able to enter the sanitization chamber through the sliding door of the booth which opened automatically once the LCD display shows "YOUR TEMP IS OK".

If the person has a body temperature value greater than the recommend value then the door remains locked with a notification on the LCD display "SORRY YOUR TEMP IS HIGH, NOT ALLOWED TO ENTER".

This machine can possibly be utilized in buildings where there is mass gathering like schools, colleges, malls, offices, etc.

Cost of the machine can also be minimized in future by selecting cost effective materials which do not compromise with the strength of the machine.

This work can be extended by using another microcontroller 'Raspberry Pi' which would in turn remove the process of adjusting the temperature sensor module by the user itself, as raspberry pi with its camera sensor and some coding will be able to detect face and will adjust the temperature sensor module once the camera detects the face, also in institutes where attendance of the employees or students is necessary to be taken, by this new microcontroller, process like taking attendance using biometrics or face recognition can be done along with this temperature screening and sanitization process.

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