



Development of an Automatic Hand Cleansing Station With Visitor Counter For Crowd Control During Covid-19 Pandemic Era

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ABSTRACT

In the modern world, there is perpetual requirement for automated device that would be designed in other to control. Crowds gathering ,which is one of major sources of transmission of CoViD-19 deadly disease as such that a proactive measures have to be put in place and focused on by reducing the number of people at a work space per time. CoViD-19 visitor counter counts the number of people entering a venue considering its capacity in order to avoid congestion. Proper hygiene is also another way to reduce the transmission of the disease among people as advised by the World Health Organization (WHO). This paper aims to control crowd in a room by designing and deploying an automatic hand-cleaning station placed at the room entrance to track movement, enhance hygiene through hand washing and to relatively reduce the environmental landfill caused by improper disposal of paper towels and the subsequent Carbon dioxide emission from burning. The visitor counter of the hand-cleaning station is designed in two parts: the proximity sensor and counter display. The sensor would detect when someone places their hand under the soap dispenser and then initiate the process of automatically dispensing tap water for about 25-30secs before allowing the use of a hand dryer and sterilizer. Thereafter, the room's door will be opened for a period of 10secs to allow access and an increment in the number of visitors being displayed on the LCD. The lock opens when a button is pressed from the inside while going out so that the door can open, and a decrement on the visitor counter is recorded. The device can be deployed for crowd control with fully practiced hand hygiene to curb the spread of CoViD-19 transmission within the citizenries.

KEYWORDS: automatic hand clean station, CoViD-19, hygiene, visitor counter.

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1. INTRODUCTION

The new Coronavirus (CoViD-19) outbreak quickly spread throughout 218 countries, territories, and regions, disrupting every aspect of human life. As of December 10, 2021, the World Health Organization had confirmed more than 267,865,288 cases, with more than 5,285,887 confirmed deaths (WHO, 2021). When an infected person hacks, snuffles, or talks, the illness spreads through respiratory drops (CDC, 2021a). The term "social distance", sometimes known as "physical separation" refers to those who keep space and other people outside their homes. For example, Setti, et al.(2020) suggested increasing social distance to reduce Coronavirus propagation. Some studies (CDC, 2020) advised that people should be kept at least 2m (6 feet) apart from one other, but others believed that 6 feet or 2m wouldn't be enough during the Coronavirus outbreak (Setti, et al., 2020).

Social distancing avoids direct contact between persons and reduces the likelihood of infection-carrying droplets from human breath from spreading — two critical components of respiratory disease. A few research studies have looked into droplet transmission routes via human respiratory behaviors like talking, eating, hacking, and wheezing while also linking the number of germs that cause severe respiratory infections to drop size, with massive droplets serving as the primary carriers of microorganisms formed by the infected person (Sun, Zhai & John, 2020).

The Coronavirus pandemic has resulted in increased hand hygiene and attentiveness. Hand hygiene is a widely accepted standard for preventing infection transmission, with legitimate cleanliness having a 24 to 31 percent chance of reducing the spread of contagious illness (Huang, Stewardson & Grayson, 2014; Kantor, 2020). The centers for disease control (CDC) recommends 20 seconds of hand washing with a cleaner and water to prevent infection spread (CDC, 2021b). The use of a cleanser is essential for hand washing to be effective, as research has shown that washing with a cleanser significantly reduces the presence of organisms on hands. Hand drying removes dampness from the hands and includes friction, which reduces the microbial burden even

more. Wet skin is more likely to exchange microorganisms and transmit organisms than dry skin, and the ecological exchange of microorganisms and transmission of organisms is more likely to occur (Hunt & Gammon, 2020).

2. LITERATURE REVIEW

Microcontroller-based bidirectional visitor counter with sanitization and thermal screening was also studied (Khusha Verma et al, 2021). There is a constant demand for automated gadgets especially as the CoViD-19 pandemic constitute the world's most serious public health crisis and the largest challenge being faced in many years especially the developed countries where thousands of lives were taking and this led to wide gap in their work force. To curb CoViD-19 disease from spreading further, the implementation of several robust protection measures is required.

In this current study, we designed, developed, and deployed a hand cleaning station system for tracking the number of persons entering or exiting a venue to avoid congestion and maintain the social distance protocol while also enhancing personal hygiene through hand washing as required. The system could be used in auditoriums, halls, schools, offices, and shopping malls, among other places. It sanitizes the visitors entering and exiting the hall, as well as checking the temperature of each visitor. If the temperature does not meet CoViD-19 criteria, a buzzer will sound, indicating that visitors were not permitted to enter the hall. The system recognized guest entry and exit based on sensor disruption (Verma, Chauhan, Singh & Kumar, 2021) anti-CoViD-19 measures in higher education institutions are being evaluated and improved.

The techniques used for assessing and upgrading anti-Corona virus (CoViD-19) strategies in higher education institutions was also considered from other authors. The administration utilized the questionnaire to get feedback from students on their dedication to safety measures as well as suggestions for how to enhance them (Rania & Isam, 2021).

The methodology combined the use of (1) Building Information Modeling (BIM) for the integration and control of anti-CoViD-19 safety measures in a 3-D



graphic environment; (2) A questionnaire to collect students' commitment to safety measures and suggestions for improvement; and (3) Data analysis to investigate the impact of students' profiles on their commitment to safety measures. The proposed methodology was used at the federal polytechnic Ilaro in the school of engineering. The findings of the paper showed that the BIM model benefits the administration by integrating safety measures in a 3-D environment and checking their compatibility as well as improving them.

Mubarak (2021), worked on the design and construction of a bidirectional visitor counter with automatic room light controller. The microcontroller was utilized to detect an entrance or exit action and to compute the figures (addition and subtraction) to obtain precise results. It collected signals from sensors, and this signal was controlled by embedded programming code stored in the microcontroller's ROM. One sensor was installed at the entrance and the other at the exit. This design, however, could also be used for a single door. The sensors were constantly monitored by the microcontroller. The microprocessor detected the blockage, computes it, and displayed it on a 16x2 LCD screen. The author suggested utilizing a sensor that could distinguish between a person and an item and created a system that saves the current count in memory in the event of a power outage (Mubarak, 2021). The device after it has been completed and put to used, it was found out to give accurate results in terms of those variables been subjected to.

3. METHODOLOGY

The method used in the design and developing of the proposed hand cleansing station in this current study is described in this section. The microcontroller-based visitor counter addresses faults in existing counters' functions. As indicated in Figure 1, the design contains four (4) primary components and circuits including the detection part (IR sensor circuitry), microcontroller section, alerting section (LCD and Buzzer), and the power supply each of the circuitry sections.

The step-by-step procedure for using the visitor counter is such that it is based on the interfacing of some components such as sensors, submersible pump

and solenoid lock with arduino microcontroller. The sensor would observe an interruption and provide an input to the controller which would run the counter increment or decrement depending on entering or exiting of the visitor.

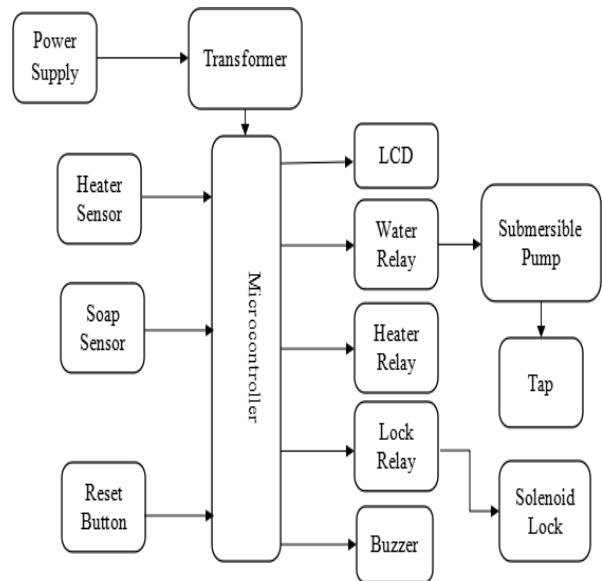


Figure 1: Block diagram of the proposed visitor counter

4. DISCUSSION OF RESULTS

This section will analyze and discuss the results and discoveries during and after the design implementation. It goes over the final design in detail and points out the potential flaws in the study. An overview of the entire study illustrates the importance and necessity of embedded systems in technological growth.

An ATmega328 microcontroller, IR sensors implanted in a soap dispenser and automatic hand dryer, resistors, diodes, LEDs, an LCD, and a buzzer are all used.

4.1 Performance Test

Before assembling the complete system, all subsystems were tested individually to verify their standard of functionality. For example, the soap dispenser was tested by putting soap into the soap

compartment and a hand was placed in front of the proximity sensor to confirm its stand-alone capability.

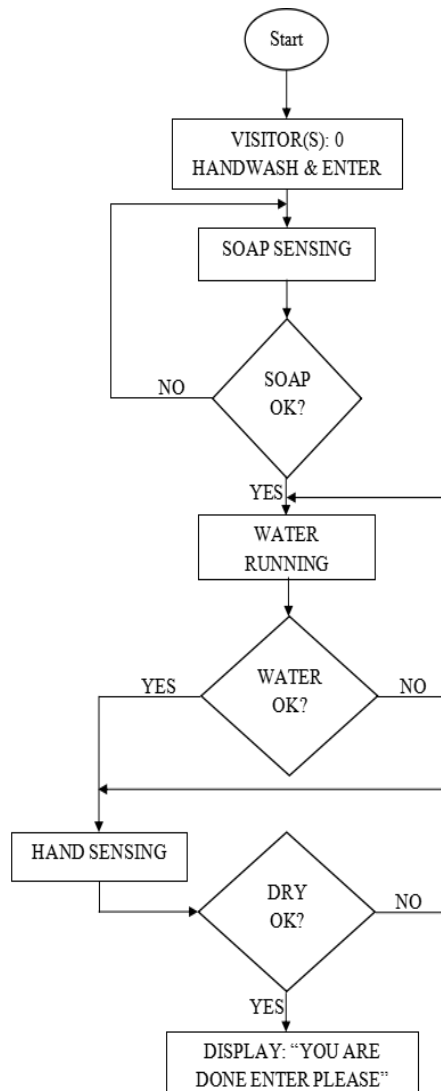


Figure 2: Flow chart of the visitor counter with automatic hand cleaning station

4.1.1 Procedures of Soap Dispense Test:

- Insert a 1.5V*4 battery into the soap dispenser.
- Pour liquefied soap into the soap compartment.
- Switch on the soap dispenser.
- Place an object in front of the IR sensor for it to dispense on.

4.1.2 Water Pump Test: this test was carried out by following these steps:

- Connect the submersible water pump to the tap hose.
- Insert the submersible water pump into a water tank.
- Power the submersible water pump by 12V battery

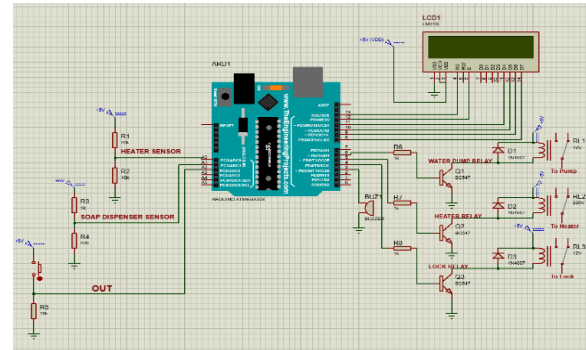


Figure 3: Circuit diagram of the visitor counter with automatic hand cleaning station

4.1.3 Hand Dryer Test: this test was performed by carrying out the following:

- Connect the hand dryer to the power outlet.
- Place the hand in front of the hand dryer sensor to test.

4.2 Presentation of Results

After successfully carrying out individual sub-system test, no fault was found. After installation, operational test was carried out on the whole system to ensure that the system was responding effectively to its given command.

From previous Research, The system developed was more efficient in nature compared to the existing ones. The system ensures that the hand is thoroughly washed and sterilized before allowing passage. One advantage of this system is that it can be implemented anywhere.

4.2.1 Soap Dispense Test Result

This was carried out to know how fast and effective the soap dispenser can dispense when the hand was

placed in front of its sensor, as seen in diagram below.

4.2.2 Water Pump Test Result

This test was carried out to know how long the tap will run for. It was noticed that the tap ran for 25-30 seconds.

4.2.3 Hand Dryer Test Result

This test was carried out to know how to know if the dryer conforms to the NCDC (Nigeria Centre for Disease Control) standard on hand drying and sterilization or not. The dryer ran for about 30-40 seconds.



Figure 4: Soap dispenser test result



Figure 5: Water pump test result



Figure 6: Hand dryer test result

5. DISCUSSION OF RESULTS

The hand wash station is mounted outside the room close to the door. The door won't open until you have first used the soap dispenser, after which the LCD will display "SOAP: OK WATER: X DRY: X DOOR: LOCK." After 5 seconds, the submersible pump is energized. It will begin to draw water out of the reservoir and cause the tap to run for about 25-30 seconds, according to the advice given by the World Health Organization (WHO). Once this process is completed, the LCD status will change to "SOAP: OK WATER: OK DRY: X DOOR: LOCK." After this, the hand dryer becomes ready for use for about 30-35 seconds. Still, the process won't start until the heater sensor senses a hand before it passes a message to the microcontroller, which will activate the heater relay. This will cause the automatic hand dryer heater to dry and sterilize the hand. The LCD will change its status to "SOAP: OK WATER: OK DRY: OK DOOR: LOCK." After 3 seconds, the microcontroller will activate the lock relay, which will open the door for 10 seconds. The LCD will change its display to "YOU ARE DONE ENTER PLEASE." After 10 seconds, the door locks, and the LCDs displays "VISITOR(S):1 HANDWASH & ENTER". When coming out, a reset switch is placed inside the room is used to unlock the door from the inside for 5 seconds. This action will reset the number of people displayed on the LCD by one decrement.



Figure 2 demonstrates a flow chart of the visitor counter. A flow chart is a diagram that represents a process, showing the steps as boxes of various kinds, and their order by connecting these with arrows. This diagrammatic representation can give a step-by-step solution to a given problem. Process operations are represented in these boxes, and arrows connecting them represent the control flow. Flowcharts are used in analyzing, designing, documenting, or managing a process or program in various fields.



Figure 7: Front view of the visitor counter with automatic hand cleaning station



Figure 8: Side view of the visitor counter with automatic hand cleaning station

6. CONCLUSION

This section presents the analysis and discussion of results and discoveries during and after the design execution. It goes over the final design in great detail

and points out the project's most likely flaws. A preview of the complete project establishes the importance and need for embedded systems in technological advancement. The block diagram of the visitor counter can be found in Figure 1. An ATmega328 microcontroller, infrared sensors implanted in a soap dispenser and automatic hand dryer, resistors, diodes, LEDs, an LCD, and a buzzer are all used in this project. The block diagram depicts the project's components.

7. RECOMMENDATIONS

After developing a system that achieves the desired outcome, it is critical to point out some enhancements that might be made to the system to increase its performance and efficiency. The following are some suggestions for enhancements:

- Incorporating a seven-segment display to show the number of visitors in the room.
- Improved for powering automatic hand dryer.

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