CONTACTLESS HAND SANITATION RECEPTACLE USING LOW-PRESSURE MISTING SYSTEM WITH BUILT-IN TEMPERATURE SCANNER

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ABSTRACT

To ensure proper hand sanitization while entering an establishment, the proponents came up with the design of The Contactless Hand Sanitation Receptacle. The proponents took the initiative to integrate a body temperature scanner into the designed device. Hence, this project's title is "Contactless Hand Sanitation Receptacle using Low-Pressure Misting System with Built-in Temperature Scanner." The concept of this project is simple yet efficient. The design consists of three parts. The first is temperature scanning. In this stage, when a user inserts their arms in the receptacle, an infrared sensor mounted in the device scans the user's temperature. If the temperature exceeds 37.2°C, a buzzer will trigger an alarm that a user might have a fever which is one of the symptoms of COVID-19. But suppose a user has an average temperature. In that case, the device will then sanitize the user's hand, which is the second part of the design. In this stage, a sanitizing solution filled in a container inside the receptacle is applied to the user's hands using a low-pressure misting system.

Keywords: *Engineering education, Arduino, temperature sensor, hand sanitation, automated sanitation, misting sanitation, COVID-19 spread prevention, Philippines.*

INTRODUCTION

COVID 19, also known as SARS-CoV-2 (severe acute respiratory syndrome coronavirus), was discovered worldwide. A health crisis arises with the virus rapidly spreading through contact and droplet transmission modalities information, airborne transmission, and fomite transmission [1]. Globally, health sanitation has been ensued to help flatten the curve of SARS-CoV-2. The virus can be transmitted by direct, indirect, or near contact with an infected person through respiratory droplet transmission. It can occur when a person shows signs of respiratory symptoms such as coughing and sneezing. Additionally, respiratory droplets can occur while an infected person contaminates an object or surface [2][3]. Due to this transmission, it has been implemented and regulated health sanitation worldwide; handwashing is one of the critical components to help reduce the information of COVID-19.

In the Philippines, a problematic scenario in managing an emergent pandemic disease due to the lack of sanitation, dense population, and poor health care delivery systems generated rapid transmission of the virus across the country [4]. With the effort of flattening the curve, The "Inter-Agency Task Force for the Management of Emerging Infectious Diseases" of the Department of Health (IATF) implemented the minimum health protocols. Hand washing practice using soap, masks, social distancing, and temperature checks to every working establishment to lower transmission risks [5]. Although handwashing with soap is one of the most effective ways to prevent transmission, it is not always possible to do so while you are outside. For that reason, hand sanitizers and alcohol are suitable substitutes.

Locally, the same minimum health protocol is also being imposed and posted by the IATF. In addition to that, the IATF has given local government units discretion to formulate ordinances that would help flatten the curve of the COVID-19 outbreak. Thus, the Province of the Davao del Norte implemented a Quick Response

(Q.R.) code scanning using the Davao del Norte COVID-19 Contact Tracing System (DCCTS). And shall be employed for the sole purpose of recording the person's entry at any given place and time within the province and can notify if they are suspect of having in contact with an infected person. Entering an establishment and in the public market strictly imposes minimum health protocol. This protocol includes wearing a face shield, face mask, social distancing, hand washing/hand sanitizing, temperature checking, and Q.R. code scanning.

The researchers observed that some people do not apply hand sanitizers correctly upon entering an establishment. Others may not apply them at all and leave them in the palm of their hands. Other establishments provide hand washing stations at the entrances. Still, we can never tell if the person entering washed their hands properly. Some may not even apply soap. Thus, the proponent came up with the idea to develop a prototype that uses electronic components and other existing technologies to address this concern through a hand disinfectant misting machine. Furthermore, to maximize the functionality of our device, we will also add a thermal scanning feature. Hence, the title of our project design is a hand sanitation receptacle with a built-in temperature scanner.

This research project aims to provide a compact system for implementing two mandatory minimum health protocols for entering an establishment: hand sanitizing and thermal scanning. The proponents also aim to ensure that every individual entering an establishment has their hand correctly sanitized. By providing a device that will thoroughly apply alcohol or any water-based hand sanitizing solution by misting.

The following are the predefined significant objectives to be attained in this design:

1) To devise a misting mechanism that can disperse alcohol or any water-based hand sanitizing solution. The instrument should
   a. Detect a user's arms when inserted into the receptacle.

b. Disperse the alcohol/sanitizing solution evenly on the hand.

c. Automatically turn off misting after a predetermined time (6 seconds) or when the user's hand will remove from the receptacle.

2) To integrate a mini hand dryer inside the misting mechanism.

3) A contactless temperature scanner using mlx90614 digital non-contact infrared thermometer can measure body temperature and view the measurements around room temperatures; the standard accuracy is 0.5°C.

4) To program an alarm system that will trigger when the temperature exceeds 37.2 °C.

5) An LCD that can display;

a. The scanned temperature in °C.

b. The remaining time of the misting mechanism until it turns off.

c. When active/ready to use, the machine's status is sanitizing or drying.

d. Notify if the operation is done.

6) To design a waterproof housing for the microcontroller and the modules (temperature sensor, motion sensor, relay, tentacle shield).

The Contactless Hand Sanitation Receptacle with built-in Temperature Scanner is capable of the following:

- Scan the body temperature of a user.
- Display the scanned temperature in the LCD mounted in front of the machine.
- Detect a user by inserting their hands inside the receptacle.
- Spray mist all over the user's hands inserted in the container for a period.
- Able to stop the operation prematurely if the hands are removed inside the receptacle.
- Partially dry hands after the misting process.

Although further improvements in the system of the design are possible, the plan is not capable of achieving the things listed below:

- Automatically refill if the tank is empty.
- Distinguish the tank's content if it is disinfectant or just plain water.

- And it cannot fully dry the hands of the user.
- Display in the LCD if the tank is running low on disinfectant.

This area comprises internet-based books, research, publications, periodicals, journals, newspapers, and other trustworthy sources. It encourages the study of Contactless Hand Sanitation Receptacle using Low-Pressure Misting System with Built-in Temperature Scanner are presented in this section.

A. Hand Hygiene

It is critical to maintaining good hygiene to stay healthy. The term "hygiene" encompasses a wide range of topics. One of them is a clean hand. Hands are frequently touched on various surfaces and might be directly contaminated. Various health agencies, notably the World Health Organization, encourage hand washing at regular intervals. One of the most critical parts of infection prevention is hand cleanliness. The severity of illness and treatment complexity increases as the burden of healthcare-associated infections grows. All of which is exacerbated by multidrug-resistant bacterial infections, prompting healthcare providers to revert to the basics of infection prevention through simple methods like hand hygiene [6].

After carrying out various activities, germs or bacteria on the hands can spread diseases like skin problems, diarrhea, and respiratory illnesses like Upper Respiratory Tract Infection and Coronavirus Droplets, on the other hand, are the most typical way for it to spread. This virus causes moderate flu symptoms such as a cold, sore throat, cough, fever, and difficulty breathing. Acute respiratory distress syndrome can develop in patients who die from multiple organ failures in a short period. Hand hygiene is It is the responsibility of everyone to avoid disease transmission. Hand washing is a simple exercise that removes pollutants from the hands and reduces the number of germs in the palms and fingers. If you want to wash your hands with water, you'll need to be near a water source. Washing hands without handwashing soap containing antiseptics will not remove bacteria from the hands. They will not

clean the microorganisms on the hands. Although not as effective, alcohol-based hand sanitizers are also an excellent substitute [7].
The occurrence of this disease has severe social and economic consequences. The World Health Organization has labeled this a pandemic disease spreading across several cities worldwide are in quarantine. To avoid contracting this virus, keep at least a 1-meter distance between you and the person and avoid overcrowded locations when outside. Avoid touching your eyes, mouth, or nose, and wash your hands with soap or a hand rub that contains alcohol. The availability of cleaning fluid containers in public places is one approach to preventing Covid-19. It is, however, currently inefficient because there are frequently touched sections, which could cause the transmission of viruses. Many prevention strategies, such as air quality monitoring, hand sanitizers, and hand hygiene, are implemented by applying automated systems [8].

B. Hand Sanitizer Solution

Hand sanitizers have been shown to reduce respiratory diseases, to lessen rates in elementary schools and illnesses in university dorms. Alcohol-based sanitizers have been shown to kill most microbes, fungi, and certain viruses. The ideal alcohol concentration to destroy microorganisms in hospitals and clinics is believed to be 70 percent to 95 percent. After 30 seconds of application, alcohol-based sanitizers containing at least 70% alcohol (mostly Ethyl-alcohol) can destroy 99.9% of bacteria on hands and 99.99 percent to 99.999 percent after one minute of application. As a result, ethyl alcohol remains the most exemplary solvent for hand sanitizers since it is cheap, readily available, and skin safe. According to numerous manufacturers, manufacturers should use Alcohol-based sanitizers in increments of 1.1 mL for optimal hand hygiene. However, employing 70% ethanol (v/v) with a recommended application amount of 1.1 mL does not guarantee complete coverage of both hands. It fails to fulfill ASTM effectiveness standards [9]

Most alcohol-based hand sanitizers, including coronavirus, effectively prevent enveloped viruses. With what is currently known in the literature, it is difficult to recommend one method of hand sanitization over another. When soap and water are not available for handwashing, sufficient sanitizer is required to guarantee full hand covering, and compliance is essential for proper hand hygiene. Given the popularity of hand rubbing alcohol during this pandemic, various hand sanitizers with varying combinations of chemicals and administration mechanisms are available. Knowing which hand sanitizers and sanitizing treatments are most effective against this new virus is critical. As the Centers for Disease Control and Prevention (CDC) stated, if there isn't enough water or soap, Use an alcohol-based hand wash with at least 60% alcohol as your next best option. [10].

Because its genome sequence is identical to that of the SARS Coronavirus, the virus is known as SARS-CoV-2 (SARS-CoV). The CoVs all belong to the Beta coronavirus genus, and their shape is enclosed, positive single-stranded RNA viruses. Besides chlorhexidine, lipid solvents including ethanol, ether (75%), disinfectants based on chlorine, and chloroform can kill these viruses. Disinfectant: 2015 WHO Model List of Essentials recommends ethanol at 80% (v/v) and isopropyl alcohol at 75% (v/v) for alcohol-based hand rub. [12]. In comparison to isopropanol (60 percent –80 percent) and n-propanol (60 percent –80 percent), ethanol (60 percent –85 percent) appears to be the most efficient against viruses [13].

Unlike soap, alcohol-based disinfectants cannot destroy such ad norovirus and clostridium, two prevalent diarrhea pathogens, are examples of bacteria. [14]. Hand sanitizers are the preferred method of hand hygiene in hospitals, although they are occasionally less effective than soap. Alcohol-based sanitizers may assist healthcare staff in complying to hand hygiene recommendations because they are widely available and take less time to use. To improve the solution of the sanitizer, about 2.5–3 mL of liquid (equal to two pumps from a dispenser) is poured upon it, rubbing all over the surfaces of both hands for about 25–30 seconds [15].

C. Alcohol-Based Hand Sanitation

Hand hygiene is essential since airborne microbe droplets quickly contaminate coughs, and sneezes can pollute them. The use of suitable hand disinfectants is crucial in preventing the virus's transmission cycle, especially in the circumstances like a pandemic. Effective hand disinfection agents, antimicrobial soaps, water-based or alcohol-based hand sanitizers, and so on are required for successful hand sanitation (the latter is frequently used in hospitals). The most effective hand disinfectant on the market today are alcohol-based formulations that include 62%–95% alcohol, which may denature bacterial proteins and inactivate viruses. This scientific review will look at the present hand sanitizer market and its effectiveness, formulation characteristics, side effects, and recommendations for improving formulation efficiency and safety. [16].

Hand disinfectants come in various types and forms, including antimicrobial soaps, water-based or alcohol-based hand sanitizers, and are primarily used in hospitals. Different delivery techniques are also developed, such as rubs, foams, and wipes. Alcohol-based hand sanitizers (ABHS) are recommended by the World Health Organization (WHO) because of their demonstrated benefits of against germs and viruses with fast action and a broad spectrum of antimycobacterial activity. [17]. An ABHS is designed to be applied to the hands to kill microbes and temporarily inhibit their growth. It may comprise one or more types of alcohol and various receivers and reactants. ABHS can effectively and swiftly kill germs over a wide germicidal range without the use of water or towel drying. However, ABHS has a few limitations, including a limited antibacterial action and inactivity of protozoa, several non-enveloped viruses, and bacterial spores are all targets.

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D. Contactless and Automatic Hand Sanitation

The emergence of technological advancement in sanitation has brought hand hygiene to a new level. The technology at hand has been adapted, developed, and even further enhanced by experts and enthusiasts in the field. This great leap has been made possible due to the persistent demand for hand sanitation and overall hand hygiene. The need for touchless automatic dispensers is identified after observing that hand washing stations and hand sanitizer containers are points of contact for contamination. Hence, the importance of contactless hand sanitation is studied, and existing devices are further developed.

Arduino Microcontrollers are one of the best options to automate hand sanitizer. The ease of use and its affordability and availability make it one of the most used microcontrollers for many automated projects. Also, the modules that are needed for the Arduino are easy to find and purchase. So far, most hand sanitizers on the market do not operate automatically [19]. With the Covid-19 rapidly growing, establishments implemented manual handwashing stations, which also caused issues that alcohol-based sanitizers spray type containers and water jugs stations outside establishment can cause contamination [20]. Due to the demand for Automatic Hand Sanitisers, hand sanitizer containers are enclosed in a housing mechanism that contains movement detecting sensors, and microcontrollers operate as dispensing machines of hand sanitizers. Various types of automatic hand sanitizer include spray and pump types. The infrared (I.R.) sensor, for example, will detect the presence of heat and motion of the object and provide data to the Arduino Uno, which will activate the pump. Suppose the water level is less than 10 cm. In that case, the ultrasonic sensor will send data to the Internet of Things, which acts as a Wi-Fi microcontroller and sends it to output devices like smartphones or (IoT). The automatic hand sanitizer testing results indicate that the system generally functions with minor data detection errors. [21].

E. Body Temperature Checking

Body temperature indicates human physiological activity and health in pediatrics, surgery, and general emergency departments. Contact mercury thermometers were employed in most early methods of monitoring body temperature. Because of advancements in electrical technology, contact-type electronic thermometers are now frequently utilized, many different types have been produced. IRTs (infrared thermometers) are quick, convenient, and simple to operate. Body temperature is measured with various infrared thermometers, including tympanic, forehead, and wrist. With the emergence of the COVID-19 coronavirus, people are being screened for the sickness using forehead and wrist temperature readings. A temperature of more than 100°F (37.8 degrees Celsius) can indicate that the body is fighting an infection, thus implying that checking a person's body temperature is very important in identifying if a person is infected with an illness or not [22].

Hand sanitation and temperature checking help decrease the transmission of the virus. Therefore, we must think of providing a convenient solution for hand sanitation and temperature checking. The machine will offer a contactless function for hand washing and temperature checking. The device will also notify the user and establishment when the body temperature exceeds its average body temperature, which will help prevent the transmission of the virus.

The proponents primarily aim for an establishment that follows the guidelines of the IATF on COVID-19, which is that every establishment shall provide a handwashing station and temperature checking for every person when entering an establishment. The design project also seeks to provide a convenient hand washing and temperature checking station that is contactless. The device will lessen the workload of a worker when monitoring a person entering the establishment. Additionally, the machine can carry a 4.5L capacity of any hand sanitizing disinfectant, which will thoroughly mist all over your hands for an amount of time.

METHOD

Research Design

The proponents designed a contactless hand sanitation receptacle using a low-pressure misting system with a built-in temperature scanner. The system is controlled primarily by an Arduino UNO. Attached to the microcontroller directly are the two 1-channel Relay Module that drives the low-pressure pump and the ceramic heating element connected to a 12v 3amp dc fan motor, infrared sensors, and temperature sensor that provides the reading for the body temperature. A piezo buzzer is also attached to the microcontroller, which provides a warning and notifies the alarm user.

A 16x2 LCD for the visible representation of the instructions and reading for the body temperature and timer for sanitizing and drying. To dispense the sanitizing solution of the receptacle, the proponents employ a programmable low-pressure misting system. Once the infrared sensor senses the hand of the user, the program will automatically initiate, starting with the user scanning their hands for body temperature and inserting the hands inside the receptacle, which will trigger the device to dispense sanitizing solution follow to dry the hands.

The goal of making this design possible is to provide a convenient solution for an establishment to an all-in-one device that can do hand sanitizing and body temperature checking. When entering the establishment—provide a low-pressure misting that can thoroughly sanitize hands much better than the automatic alcohol dispenser. Also, this design is made to be flexible enough for future use and upgrade.

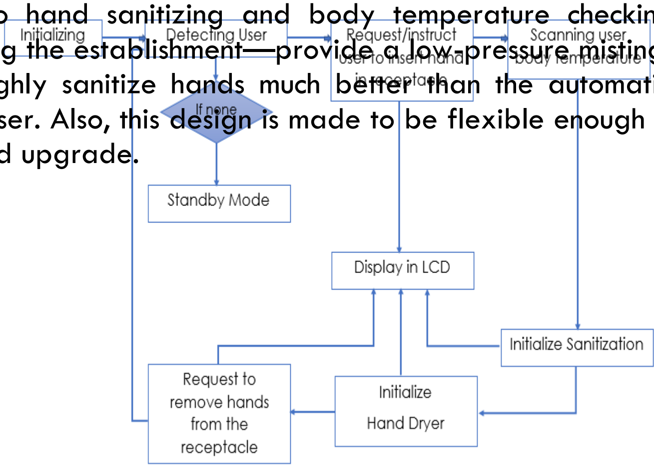


Fig. 1 Conceptual Framework

Conceptual Framework

The designed Contactless Hand Sanitation Receptacle using Low-Pressure Misting System with Built-in Temperature Scanner is controlled primarily with an Arduino Uno Rev 3. The 1-channel Relay Module directly drives the 12-volt water pump, the heating element, dc fans, and the Led lighting inside the receptacle attached to the microcontroller directly. Also connected in the microcontrollers are the temperature sensor, infrared sensors, piezo buzzer, a 16x2 LCD for the presentation of data read by the temperature sensor, and other instructions given to the user shown in the block diagram in Figure 2.

The temperature sensor we will use in this project is an mlx90614 non-contact infrared thermometer. And to make the temperature reading more accurate, we integrated an infrared sensor to ensure that the result is always precise from the same distance every time it reads a user's temperature. It will then be displayed the temperature reading in the LCD attached to the device. A piezo buzzer will trigger a temperature reading exceeding 37.2℃, alerting any personnel near the machine. If a user has an average temperature, the device will proceed with the sanitization process. A 12-volt low-pressure water pump is submerged in a container filled with sanitizing solution. It will pump it through a misting nozzle inside the receptacle. After the sanitization, the ceramic heating element will trigger the 12v 3amp dc fan motor, drying the user's hands. The conceptual framework is shown in *Figure 1*.

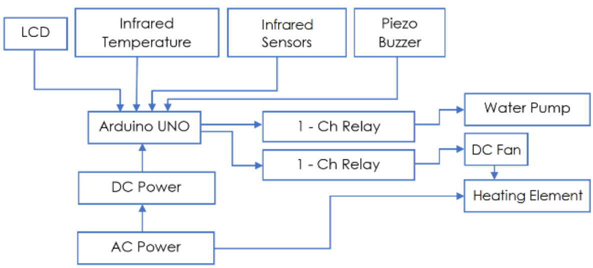


Fig. 2 Block Diagram

Research Project Duration

The project's implementation would take one semester on average (equivalent to 5-6 months).

Multiple Design and Constraints

Trade-off Analysis. The design considered two concrete ideas during the design process. The plan will thoroughly examine them based on the following factors, which will assess the project's relevance and effectiveness.

Design 1

Design 1 for Contactless Hand Sanitation Receptacle using Low-Pressure Misting System with Built-in Temperature Scanner uses a 3mm misting nozzle attached to a low-pressure water pump. The type of nozzle we wanted to use is the 3mm and 4mm misting nozzle in this design. For the first testing of misting, we use the 4mm misting nozzle shown in Figure 1. However, the 4mm misting nozzle cannot mist appropriately attached to the low-pressure water pump. We then tried to mix the two misting nozzles of the 3mm and 4mm misting nozzles shown in Figure 2. However, the output of consisting the two misting nozzles wasn't pumping enough mist to wet the hands.

Fig. 1 4mm misting nozzle

Fig. 2 3mm and 4mm misting nozzle

Design 2

Meanwhile, the misting nozzle for the low-pressure misting system in the contactless hand sanitation of the second design has been modified to make it flexible for future use, and developments are shown in Figure 3. Also, it can easily connect misting nozzle since the hose pipe for the new nozzle are flexible and easy to attach.

Fig. 3 Misting nozzle

Fig. 4 Misting nozzle w/hose pipe

Design 1 vs. Design 2

Overall, both designs utilize the same equipment and electronic components. However, in design 1, the misting nozzle wasn't compatible with the low-pressure pump. Meanwhile, in design 2, the proponents consider the system's flexibility. Although the previous misting nozzle can mist when operating, the new misting nozzle provides more expansive coverage than the previous one, which is also compatible with the low-pressure pump because of its flexibility.

Research Procedure

The whole process of making the design includes Conceptualizing, Planning, Organizing, Implementation, and Evaluation.

In the conceptualization procedure, the proponents made a series of deliberation, sharing ideas on what is best suited to be a viable design in the future. One of the significant considerations in coming up with the idea of creating a low-pressure misting system for contactless hand sanitation, since contactless hand sanitation is one of the factors in preventing the transmission of COVID-19.

The researchers gather out all possible and related information and ideas in making the design. Afterward, sort out the ideas and all other information to finalize the plan's construction. Purchasing the needed materials is one of the topmost priorities and programming the system for a specific design function. The distribution of tasks per member is also required for there will be many things to be done within a short period.

Coding the program for the design took a lot of time which is why the implementation also takes a month to be achieved. A series of troubleshooting each part of the system is done to ensure the workability of the design.

Overall, the proponents have achieved what is conceptualized, as shown in the prototype checking.

Hardware and Software Specification

Software

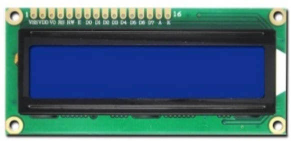
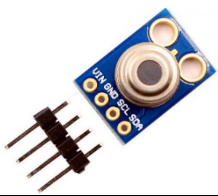
In the coding process for the design system, the software used is Arduino IDE. This software helped a lot in compiling the programming code for the design.

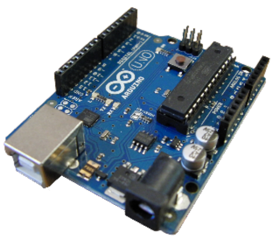
Arduino IDE. The Arduino Integrated Development Environment is a cross-platform application written in Java's programming language. It is used to write and upload programs to the Arduino board. It supports the languages C and C++ using special rules of code structuring.

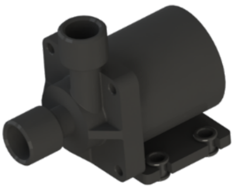
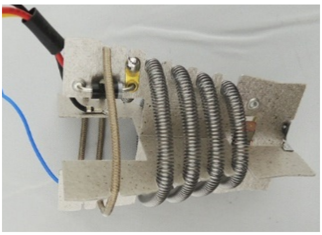
The Arduino enthusiast community helped the researchers start the Arduino-based project.

Hardware

Listed below are the major electronically related components used upon the design's construction. Each component is defined with provided description on the second row of the table.

	16x2 LCD – An LCD Display module compatible with Arduino UNO.
	MLX90614 – Non-contact infrared temperature sensor.

	Infrared Sensor – Detects the motion of the object.
	Piezo Buzzer – Provides alarm tone for the device.
	Arduino UNO Rev3 – A microcontroller board based on the Atmega 328. It has 14 digital input/output pins (of which six can be used as PWM outputs), six analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header, and a reset button.

	1 Channel Relay Module - Control A.C. mains when connected to Arduino.
	12V Low-Pressure Water Pump – Pumps the water from the container.
	Ceramic Heating Element – Provides heating for the blower.

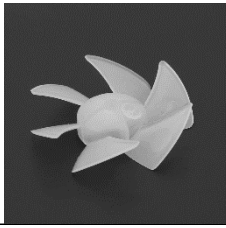
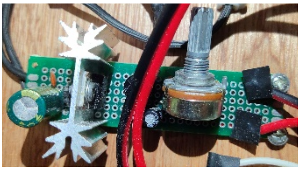
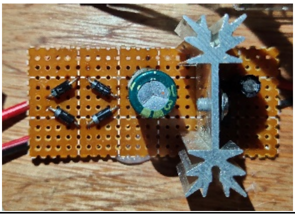
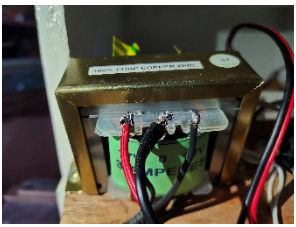
 	D.C. Fan - Attach to the ceramic heating element, which provides airflow for the blower.
 	Voltage Regulator – Provides and maintains the proper voltage level for the modules.
	Center Tap Transformer – Converts a high voltage to a lower voltage.

Table 1. Hardware Specifications

RESULTS AND DISCUSSION

The succeeding figures are the results gathered by the proponents during the testing and simulation of the prototype design.

Hand Sanitation Receptacle with Built-in Temperature Scanner: A fully automated hand sanitizing station and temperature scanning device can be classified into three parts. The first part is the temperature reading; the machine will only proceed to the next part if the user's temperature is at the normal range and is set to alarm if a user's temperature exceeds 37.5oC.

For this part, the proponents underwent a series of trials. The first is to scan a user with an average temperature to see if the machine will proceed to the next step. The second test is to induce heat in the hand of the user to make it hotter and test the scanner if it will still proceed to the next step or will it trigger the alarm if the temperature exceeds the average body temperature.

Fig. 1 Normal Body Temperature

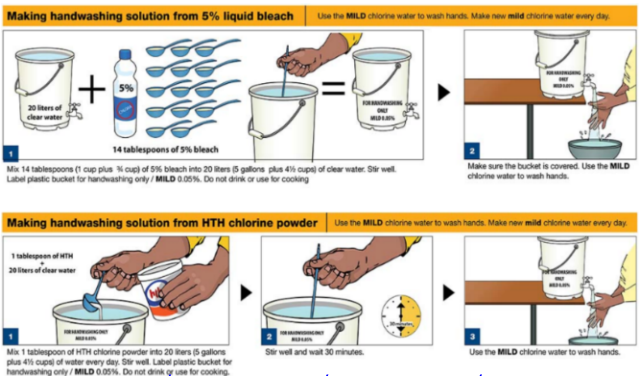
Fig. 2.1 High Body Temperature

Fig. 2.2 Restart Device

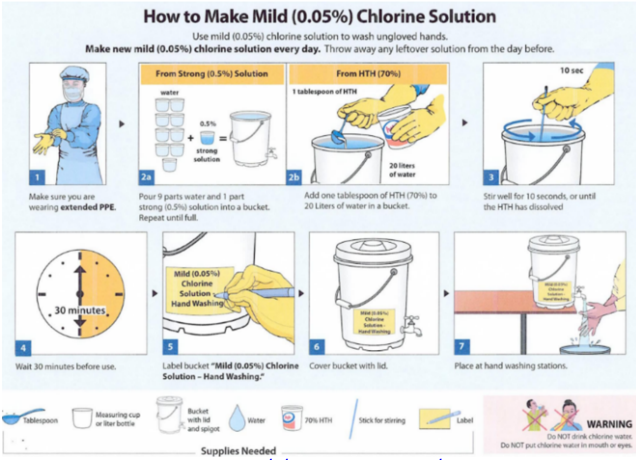
The figure seen above is the process of scanning the user's temperature. In figure 1, the temperature is within the normal range and proceeds to the next part, the sanitizing. However, in figure 2, the induced heat made the hands of the user hotter, which triggered the alarm and displayed a high-temperature warning and proceeded to ask for a device restart (figure 2.2). Below is a chart showing the body temperature range.

Classed as:	Celsius
Hypothermia	<35.0°C
Normal	36.5 - 37.5°C
Fever / Hyperthermia	>37.5 or 38.3°C
Hyperpyrexia	>40.0 or 41.5°C

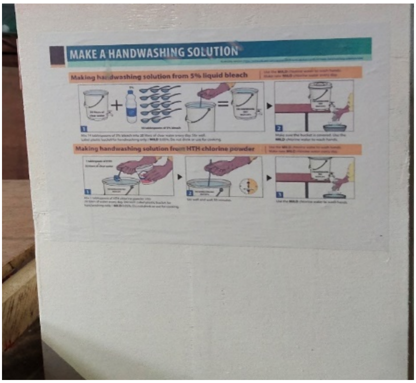
Testing the second part of the device, the proponents first made a handwashing solution recommended by the CDC (Centers for Disease Control and Prevention) and DOH (Department of Health), which is also labeled in front of the machine shown in the images below.



https://www.cdc.gov/coronavirus/2019-ncov/global-covid-19/make-handwashing-solution.html



https://doh.gov.ph/



Mild chlorine solution is labeled in front of the machine.

After making the mild chlorine solution, to ensure that the misting device is working correctly, the researchers tested the misting system that sprinkles the sanitizing solution in the hands of the user. In figure 3, the LCD mounted on the front of the machine shows that the sanitizing process is in work. We also tested the sensors in the sanitizing receptacle by removing the users' hands prematurely. As intended, the machine would ask the user to insert its hands again in *Figure 4* and finish the sanitizing process.

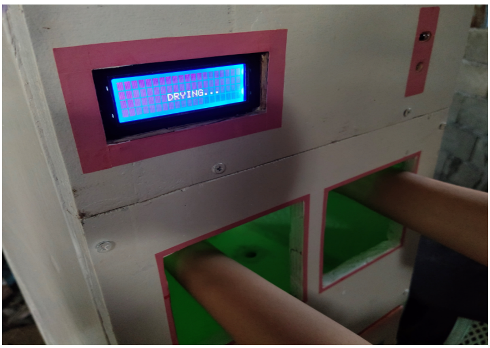
Fig. 3 Hand Sanitizing

Fig. 4 Initializing Hand Sanitation

The final stage of the device is hand drying. In this stage, we tested the hand dryer. As stated in the objectives of this research, the hand drying mechanism could not fully dry the hands of the user. Nonetheless, it will leave the hand in a semi-dry state, still moist but not dripping with water. *Figures 5 and 6 show the before and after using the integrated dryer, respectively*. The dryer will turn on for 30 seconds; however, users can remove their hands if they feel that their hands aren't dripping with water anymore. The LCD screen will also display the Drying process while at work. *See the figures below.*

Fig.5 Wet Hands

Fig. 6 Semi-Dry Hands



LCD Display indicating that the dryer is at work.

Conclusion

The functional testing of the design shows that the system is working. The temperature scanner reads the temperature of the users. It works as an alarm if the device's person has a high temperature or possibly has a fever. The system will not continue its functions if it does have a high body temperature. The misting system also works well with the mild chlorine hand washing solution recommended by the DOH (Department of Health) and the CDC (Centers for Disease Control and Prevention). Even though the integrated hand dryer in the device cannot fully dry the hands of the user, the dryer can help remove the excess water in the hands of the user after the sanitizing process. The overall duration for the operation of the device is approximately 40 seconds. The hand drying process is optional without the hand drying procedure. The whole operation can come down to about 10 seconds.

Recommendation

There are still many things that need to be improved in the project design. However, the proponents are not able to do so. Therefore, the proponents would like to suggest further design developments to add a water level sensor for the operators to know when to add additional water solutions. Also, the addition of a more powerful blower for the hand dryer can fully dry the hands of the user.

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