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FogClean: Fog Disinfection Dry Hand Washing Machine

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ABSTRACT

Given the urgent need for efficient hand hygiene solutions, the current work presents a novel approach to hand washing that makes use of an Arduino-based device that is outfitted with ultrasonic sensor technology and fog disinfection. In this regard, this facility provides an ideal solution that is quick and simple to use, particularly when traditional handwashing options are limited or challenging to use. One of our system's most crucial functions is to produce a fine mist or fog that contains a disinfectant solution. The user then applies this spray to their hands. An Arduino microcontroller serves as our main processor, managing many apparatuses like sensors, valves, and pumps. Through the use of an ultrasonic sensor, this device recognises hands and initiates the disinfection process.Evaluating the effectiveness of the system in achieving deep hands sanitation conserved water dry needs. Moreover, this paper discusses design, power consumption, security standards and scalability of whatnot to explore feasibility of this particular solution in reality contexts.

Keywords: hand washing, Arduino, ultrasonic sensor

INTRODUCTION

During the Covid-19 pandemic, hand washing was a daily need.In the face of increasing disease severity and treatment complexity, as well as a global pandemic of multidrug resistant pathogen infections, health care professionals are increasingly turning back to the basics of infection prevention using basic techniques like hand cleanliness[1]. When they wash their hands with soap, many people have a tendency to leave the tap running. In that instance, it is advantageous to have an automatic contactless tap in order to prevent cross-contamination and conserve water. About 20–30% of the water that is wasted by the system when washing hands is still run over hands[2].

In order to address the problem at hand this research has led to this solution of FogClean.This contactless dispensing gadget sprays an alcohol-based hand sanitizer when both hands are placed underneath it. To ensure optimal efficacy, only 5 to 6 mL of sanitizer are needed for the foamy mist-based solution. Using an ultrasonic sensor, contactless technology ensures no touch and superior precision while simultaneously sanitizing both hands. With LED displays to indicate the process's progress and on/off status, it might be wall-mountable.

There are two methods for washing our hands: using soap and water or alcohol-based hand sanitizer[3]. When our hands are obviously filthy, we wash them with soap and water. Our hands need to be cleaned often with soap and water or alcohol-based hand sanitizer when they are not obviously unclean. Every day, a significant amount of water is wasted due to frequent hand washing[4].We're going to use a machine that sanitizes hands by using water vapor or fog. Fogging as a disinfection method is a more recent innovation.

Study Area:

There is research that offers important new information on how well dry fogging, a method of airborne disinfection, works to inactivate bacterial spores, mycobacteria, and SARS-CoV-2. The study highlights the potential of dry fogging as a strong disinfection technology by demonstrating via extensive trial how successful it is at neutralizing these bacteria. The study also clarifies the drawbacks of using commercial spore carriers, which are frequently employed in dry fogging systems. The research provides important insights for enhancing disinfection procedures and raising the general efficacy of airborne disinfection tactics by recognising these limitations[5].

A team of scientists evaluates and discusses the use of dry fogging with peracetic acid (PAA) to clean hospital surfaces infected with SARS-CoV-2. This indicates that, in light of the COVID-19 pandemic, there is an urgent need to address the crucial problem of hospital disinfection. The effectiveness of dry fogging with peracetic acid is the researchers' main concern." The writers have included helpful details on how it lessens the spread of viruses, promoting a secure environment for interactions between medical professionals and the ill. The potential of peracetic acid as an effective disinfectant against SARS-CoV-2 on various surfaces is emphasized; this will help create evidence-based decontamination standards for healthcare facilities[6].

The research presents a novel approach to hand hygiene with its Automated IoT Based Fog-Based Hand Wash System. Driven by Internet of Things (IoT) technology, the gadget suggests a useful and automated method of hand washing, which is an important societal hygiene concern in these coronavirus-ridden times. The safety component of fog-base disinfections is explained by a variety of implementations, and the Internet of things guarantees autonomous and seamless operations through monitoring. This article may represent a major advancement in the field of hand hygiene technology since it examines potential applications in a range of settings, including food outlets, public restrooms, and healthcare facilities[7]

This paper will present the results of their investigation into the potential uses of a dry hydrogen peroxide mist for sanitizing low-maintenance medical equipment. In their research, they emphasize the need to close a gap in order to prevent hospital diseases from spreading. The authors provide insightful information that will aid in assessing the efficacy of dry mist hydrogen peroxide as a substitute disinfection method. This is particularly crucial in hospital settings where hygienic conditions are of the highest importance.The findings show the importance of using dry mist machines to add hydrogen peroxide to the air surrounding patients in addition to protecting them and preventing the spread of germs within hospitals. Thorough disinfection techniques are crucial for preventing diseases associated with medical care[8].

In the study, a unique touch-less hand disinfection technique utilising UV lights and Arduino was presented. This research proposes a hands-free sanitation procedure using Arduino and UV lights, which makes it crucial for attempts to stop the spread of infectious illnesses. By integrating Arduino with the system, decontamination operations may be managed more precisely, improving system accountability and user-friendliness while eliminating germs[9].

METHODOLOGY

Components

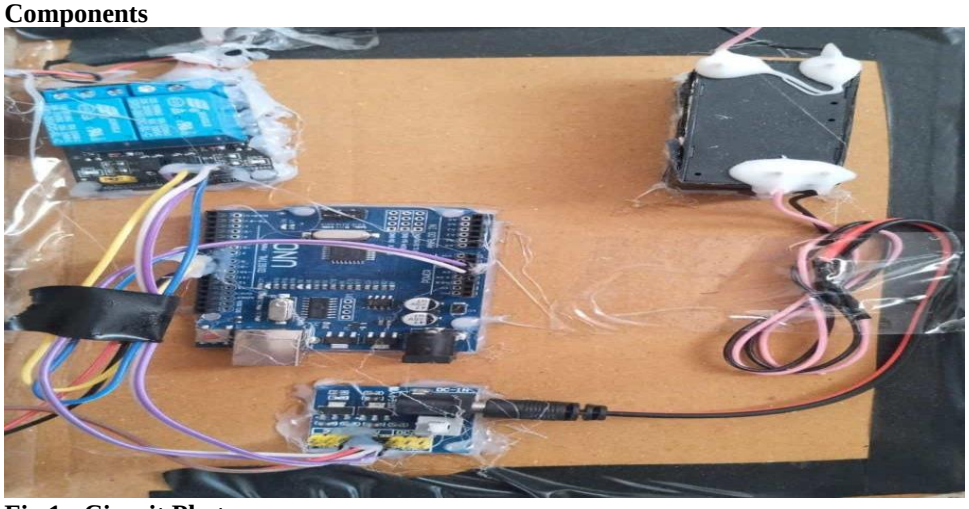

Fig 1 : Circuit Photo

1. **Arduino Uno:**

You may have noticed that the Arduino Uno microcontroller platform has gained popularity because of its versatility and ease of use in electronics projects and prototyping. Its built-in Atmega328P microprocessor puts it at the pinnacle of performance, which explains its wide range of applications.The many output/input ports on the Uno make it simple to connect to a variety of very sensitive analogue or digital sensors. Furthermore, it can communicate with other devices like actuators and displays thanks to other interfaces including UART, SPI, and I2C. The straightforward syntax and extensive library support of the Arduino IDE (Integrated Development Environment) make it easy to use[10].
We decided on an Arduino Uno microcontroller, which is well-known for being simple to use and having cutting-edge functionality for electronics projects. With the Arduino Uno serving as the primary controlling component and employing high-level algorithms for the most straightforward regulation of the fogging process and handwashing exercise, the Fog Disinfection Dry Hand Washing System functions as intended when integrated.

The Arduino Uno regulates the fogging mechanism's activation and deactivation, releasing disinfectant fog in a timely manner to sanitise hands as effectively as possible. The Arduino Uno interfaces with sensors, such as ultrasonic sensors that detect hands when they are near the gadget, to precisely initiate the fogging process. This function helps avoid resource waste that might result from the machine running unnecessarily in addition to improving sanitation efficacy.

The Arduino Uno plays a crucial role in controlling the hand washer's other parts, which include actuators, sluice valves, and pumps. These parts (actuators, sluice valves, and pumps) are used to control the fogger's flow and discharge water and disinfection solutions. With its programmable inputs and outputs, these parts are able to be coordinated and synchronised, enabling the hand washing machine to function smoothly and easily for the user.

Fogging system dependability may increase for those who use the Arduino Uno. It is likely to have safety measures like temperature sensors that can stop the fogging system from overheating or pressure sensors that may identify obstructions in the dispensing lines. Because they can be confident that this equipment will yield the greatest results possible, users can rely on it.

2. **Ultrasonic Sensor :**

A fog disinfection dry hand washing machine's ultrasonic sensor primarily relies on it to identify hands before disinfection begins. It is a gadget that measures an object's distance without making physical touch by using ultrasonic sound waves. Optimally positioned inside the apparatus, it continually emits ultrasonic waves and measures how long it takes for them to reverberate off nearby objects, like human hands. In order to determine with accuracy how far this sensor is from its target item and, consequently, if hands are close, the reflected signals are examined.

The hand washing machine operates touchless thanks to the use of an ultrasonic sensor, which makes it extremely important for preserving cleanliness and lowering cross-contamination. When a user's hands approach the machine, the ultrasonic sensor recognises them and sends a signal to the Arduino controller to start the fogging process. This automation ensures that, when necessary, the disinfectant mist activates precisely when it should, enabling effective hand disinfection while also promoting resource conservation.

Moreover, an ultrasonic sensor that facilitates easy and natural contact makes using the hand washing machine a more pleasurable experience. Without physically touching any buttons or switches, this device initiates the disinfection process whenever a user's hands are within its range.

3. **Fog System:**

The fog system in our instance is a device that sprays extremely fine water particles combined with disinfectant solutions , in this case such as sanitizer into the atmosphere. When these particles come into contact with surfaces or other objects, they kill any germs or other microorganisms that may be present. When used in conjunction with the Fog disinfecting Dry Hand

Washer, the fog system provides an ideal means of rapidly removing dirt from hands by the application of her disinfecting mist

The fog system, which is housed inside the hand washing machine, is responsible for producing and releasing the germ-killing fog onto the user's hands. It typically consists of reservoirs, pumps, and nozzles in addition to a control mechanism that makes sure the process of creating the fog is appropriately regulated. When the fog system is turned on, a fine mist covers the user's hands as a result of the nozzles atomizing an aqueous disinfectant solution that has been combined with water from the reservoir. therefore guaranteeing optimal disinfection by rendering any germs on the skin's surface inactive; this mist guarantees sufficient coverage even inside the hands in question's cracks and fissures." .

The fog system is controlled by microcontrollers like Arduino and is integrated with sensors like ultrasonic sensors for hand detection. This enables the gadget to operate in automated synchronisation with the user's hand washing routine, resulting in increased user comfort. This kind of automation not only makes things simpler, but it also guarantees that our model consistently disinfects hands with trustworthy outcomes.

4. **Power Module and Relay Module :**

For the functionality and operation of the Fog Disinfection Dry Hand Washing Machine, it relies on the power and relay modules.

The power module serves as the system's power supply, providing sufficient electrical power to operate the various parts, such as the microcontroller, sensors, pumps, and fogging system. In general, it transforms the incoming voltage from any ordinary power source such as the battery or the mains into values that are helpful for operating the equipment. Furthermore, it keeps the system's power distribution consistent and constant, guarding against voltage fluctuations that would harm the system's delicate electrical components.

The purpose of the relay module is to let microcontrollers that are unable to directly handle the necessary voltage or current manage or switch big power-hungry devices like pumps and misters.A relay module contains one or more electromechanical switches called relays. The microcontroller provides low-power signals to the relays, which enable them to be controlled. The relay links a higher-power circuit when it is turned on by activating an input, enabling the microcontroller to reasonably adequately manage the actions of such components.

Continuous and reliable supply of electricity to all components necessary for uninterruptible equipment operation is ensured by the power module. Key equipment parts are turned on or off using the relay module that is in control of such actions and operations happening.

5. **DC Jack :**

Electronic equipment employs a standardised interface called a DC jack, sometimes called a DC power connector, to connect an external power source. The Fog Disinfection Dry Hand Washing Machine may receive power from an external power source, such as a wall adapter or battery pack, via an interface called the DC jack.

Engineers use a cylindrical connector, consisting of an outer shell for negative voltage and a centre pin for positive voltage, when creating a DC jack. The purpose of this cylindrical connector is to establish a secure and dependable connection by receiving a corresponding plug from the power supply.

6. **Water Tank** :

One important aspect of a fog disinfection The water tank that is utilised for fogging is the Dry Hand Washing Machine. Usually located within the device, the water tank has adequate capacity to disinfect hands several times. The mechanism will

gather water from the water tank, mix it with a disinfectant solution, and then release a fine mist or fog that is suitable for hand sanitization. Water will always be accessible for a longer amount of time without needing to be constantly refilled if the water tank's capacity is designed to match the demands of the machine during operation.

The design of the water tank incorporates features such as removable lids and reachable apertures to make maintenance and refilling simple. This makes it easy and comfortable for consumers to use the hand washing machine.

7. LED :

When an electric current powers a semiconductor, the material emits light. The Fog Disinfection Dry Hand Washing Machine uses Light Emitting Diodes (LEDs) for a variety of functions, including operational feedback, status indicator, and user interface.

This LED is connected to the control circuitry that is frequently managed by a microcontroller that resembles an Arduino and is mounted on the control panel or machine surface. Therefore, as soon as the fog machine starts up, the microcontroller will send a signal to this LED, causing it to light up and indicating that the flogging operation is underway. By doing this, users may try out the various modes on the gadget or even alter its parameters with ease because they get instantaneous information about what happens as it works over time.

Light Emitting Diodes' extended lifespan and low energy usage make them an ideal choice for a hand washer. They maximise the machine's energy efficiency so that it may be operated for extended periods of time without adversely affecting the power supply or battery life.

Working :

Launch the System : Upon switching on the Fog Disinfection Dry Hand Washing Machine, the system starts running by going through certain procedures like ensuring all parts work well as well as booting up and calibrating or detecting the hands-sensing sensor accurately. To make sure the foggers are operating properly, a test must be conducted before any fog is produced. Furthermore, the system will just wait till the foggers start working if they don't at first. Subsequently, the fog maker transforms the disinfection solution into minuscule droplets, causing the system to reroute its processes and produce a delicate magic mist. Lastly, in the hand room, one can clean their hands with this gentle mist.

Prepare Fog Disinfection: Following the system's activation, the disinfection solution will begin to be consumed in tiny droplets. The purpose of the fog produced during this procedure is to guarantee that every user's hands are thoroughly cleaned.

Incorporate Fog Into Hand Chamber: The machine works by transferring its internal fog to the space that has been specifically created for it. This is the area where someone washing their hands must put their hands. This fog fills the entire Hand Chamber, guaranteeing that hands are properly and totally sanitised.

Facilitate Hand Cleaning: The system asks the user to proceed and clean his hands after the fog in the Hand Chamber has had time to settle and is used to disinfect hands. This is meant to imply that individuals should start washing their hands now that the fogging process has ended.

Verify Your Hand Sanitization: In order to determine whether or not someone has cleaned their hands, it is necessary to assess a variety of factors, including the degree of mist exposure and the hand's residual contamination status. Only after it is verified that the hand was sanitary is the next course of action done. If not, the system reverts to Step 2 so that the procedure can be carried out again.

Finish the process and stop : The sterilisation process is terminated when the machine shuts off after properly cleansing the hands. It gives users feedback on how thoroughly their hands have been sanitised visually. Additionally, by doing this, power is saved and the appliance is prepared for use later. The working can be understood through the flowchart shown in figure 2

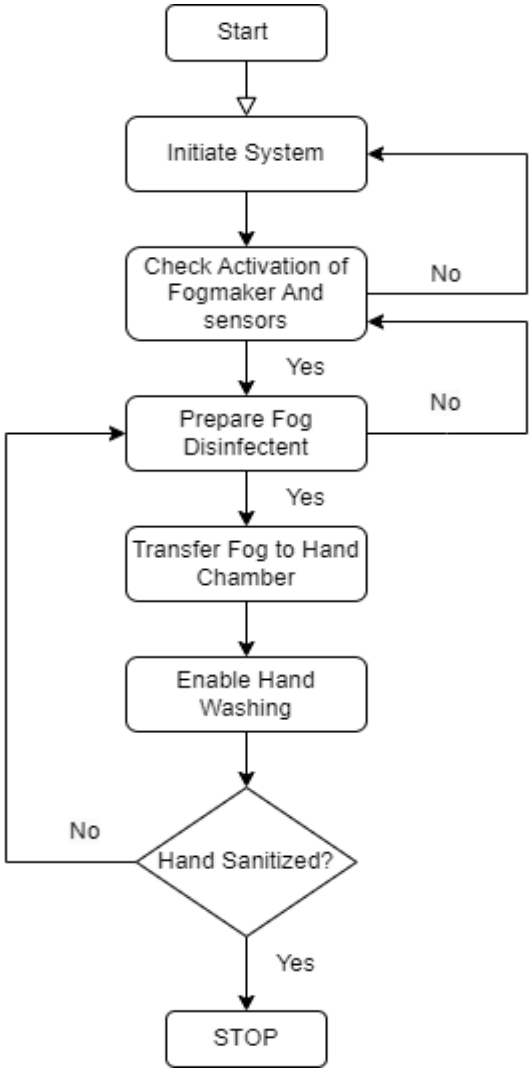

Fig 2 : Flow chart

RESULT & FUTURE SCOPE

Result and conclusion

The numerous intriguing advantages of the suggested approach include innovative hygienic procedures in locations like theaters, airports, and train stations. Encouraging safer surroundings by selectively eradicating bacteria and viruses aligns with the principle of appropriate social distancing. This technique does not require physical touch or compromise on other widely recognised standards of hygiene in order to improve public safety.

Furthermore, its portable design allows for easy installation and use in a variety of locations, meeting a range of demands and preferences. Even though it's not steady yet, the well-established advantages of its innovation eliminate doubts. Furthermore, this technique utilises around 95% less water for cleaning than what has previously been used, making it a workable solution to preserve water for future generations. Because it is completely automatic, you won't have to worry about mishandling or leaking faucets, which will certainly improve our attempts to conserve water.

This system's automated feature saves you water and eliminates the hassles associated with installing and maintaining a traditional tap system. Because of this, you can use it comfortably and hygienically without having to touch it, improving your safety and health. Simply put, when society advances, a flawless model is recognised as a significant milestone in advancing sustainability and public health, which fosters widespread acceptance and furthers ongoing innovation in the field of hygiene technology.

Future Scope

Improved Pathogen Identification: cutting-edge technology and sensors Integration of Artificial Intelligence (AI) algorithms that swiftly identify various viruses and bacteria for particular disinfection protocols that may be required since then could make a machine that assists in the instantaneous detection and analysis of hand pathogens more effective.

Smart Connectivity: If put into practice, IoT (Internet of Things) capabilities would make it possible to remotely monitor, manage, and analyse data on numerous machines spread across various geographic locations. Furthermore, smart connectivity can be used to achieve automated maintenance notifications or low disinfectant alarms, which would ensure seamless operation.

Adjustable Disinfection Settings: Offering consumers the ability to adjust disinfection settings in accordance with their needs or preferences may improve flexibility and user experience. This might contain settings for changing the amount, duration, or disinfectant concentration of the fog according on the preferences of the user or the surrounding circumstances.

REFERENCES

[1]. E. Bentivegna, M. Luciani, L. Arcari, I. Santino, M. Simmaco, and P. Martelletti, “Reduction of multidrug-resistant (MDR) bacterial infections during the COVID-19 pandemic: a retrospective study,” Int. J. Environ. Res. Public Health, vol. 18, no. 3, p. 1003, 2021.

[2]. Roy, Akash, Baban Rindhe, Samruddhi Nakhwa, Nitin Chaudhary, and Jagruti Barade. "Automatic Dry Hand Sanitizing Device."

[3]. Grayson, M. Lindsay, Sharmila Melvani, Julian Druce, Ian G. Barr, Susan A. Ballard, Paul DR Johnson, Tasoula Mastorakos, and Christopher Birch. "Efficacy of soap and water and alcohol-based hand-rub preparations against live H1N1 influenza virus on the hands of human volunteers." Clinical Infectious Diseases 48, no. 3 (2009): 285-291.

[4]. Othman Ahmed, Kaywan. "Impact of COVID-19 pandemic on hand washing process and water consumption." Eurasian Journal of Science & Engineering 7, no. 1 (2021): 228-245.

[5]. Schinköthe, Jan, Hendrik A. Scheinemann, Sandra Diederich, Holger Freese, Michael Eschbaumer, Jens P. Teifke, and Sven Reiche. "Airborne disinfection by dry fogging efficiently inactivates severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), mycobacteria, and bacterial spores and shows limitations of commercial spore carriers." Applied and environmental microbiology 87, no. 3 (2021): e02019-20.

[6]. Cutts, Todd, Samantha Kasloff, David Safronetz, and Jay Krishnan. "Decontamination of common healthcare facility surfaces contaminated with SARS-CoV-2 using peracetic acid dry fogging." Journal of Hospital Infection 109 (2021): 82-87.

[7]. Siri, Kola, Bolla Kalyani, Banda Yashwanth Reddy, D. Dhanalakshmi, Sowmya Mandala, and Shanmugasundaram Hariharan. "Automated IoT Based Fog-Based Hand Wash System." In 2023 International Conference on System, Computation, Automation and Networking (ICSCAN), pp. 1-6. IEEE, 2023.

[8]. Amodio, Enrica, Stefan P. Kuster, Christian Garzoni, Annelies S. Zinkernagel, Hugo Sax, and Aline Wolfensberger. "Disinfecting noncritical medical equipment—Effectiveness of hydrogen peroxide dry mist as an adjunctive method." American journal of infection control 48, no. 8 (2020): 897-902.

[9]. Kumar, T. Sathies, and Abirami Venkatraman. "Contact-Less Hand Disinfection Using Arduino and UV Lighting." In 2023 Intelligent Computing and Control for Engineering and Business Systems (ICCEBS), pp. 1-5. IEEE, 2023.]

[10]. Hoffman, Jon. *Mastering Arduino: A project-based approach to electronics, circuits, and programming*. Packt Publishing Ltd, 2018.