ISSN 2347 - 3983
Volume 12. No.5, May 2024
International Journal of Emerging Trends in Engineering Research
Available Online at http://www.warse.org/IJETER/static/pdf/file/ijeter041252024.pdf
https://doi.org/10.30534/ijeter/2024/041252024

Clear hands, Clear conscience: Fog disinfection, dry hand washing

Prof.T.Srilatha [1],A.Srinidhi [2],P.Vaishnavi [3],R.Kavya [4],Shaima [5]
[1] Professor, G Narayanamma Institute ofTechnology and Science, India, latha.gnits@gmail.com
[2] Student, G Narayanamma Institute of Technology and Science, India[2] srinidhiamirishetty@gmail.com,
[3] Student, G Narayanamma Institute of Technology and Science, India [3] polepallevaishnavi0405@gmail.com ,
[4] Student, G Narayanamma Institute of Technology and Science, India[4] ryakalakavya@gmail.com ,
[5] Student, G Narayanamma Institute of Technology and Science, India[5] shaimahmedx@gmail.com

Received Date: March 22, 2024 Accepted Date: April 27, 2024 Published Date : May 07, 2024

ABSTRACT
Proposing a water-saving hand washing solution, we introduce a system designed to reduce water usage by over 95%. Highlighting the importance of hand hygiene in combating pandemics, we challenge the notion of excessive water requirement for effective disinfection. Our system, controlled by an Arduino microcontroller, incorporates ultrasonic sensors, mist maker, UV lamp, and timer buttons. It activates mist and UV components based on user-selected time, ensuring efficient disinfection. Alerts are issued if hands are prematurely removed, enhancing hygiene without water wastage.

Key words: Arduino microcontroller, Ultrasonic sensors, hygiene, Dry hand washing

1.INTRODUCTION

Since the emergence of the COVID-19 pandemic, the recommendation for frequent hand washing has become increasingly prevalent. However, alongside this imperative, arises a pressing concern regarding the substantial wastage of water inherent in conventional hand washing practices. To confront this issue head-on, we have pioneered the development of a cutting-edge system engineered to drastically reduce water consumption by over 95%. Despite the undeniable importance of hand disinfection in combating the pandemic [1], the question of whether it truly necessitates such a copious amount of water remains pertinent. It is worth noting that many individuals inadvertently squander water resources through prolonged hand washing routines, which, in actuality, may not be essential for effective disinfection. In essence, the key to optimal disinfection lies in ensuring that water and disinfectant reach every nook and cranny of the hands [2], rather than simply relying on sheer volume. Taking a progressive leap towards sustainable water management, our innovative system introduces a fog-based methodology to revolutionize traditional hand hygiene practices. At its core, the system is driven by an ARDUIINO microcontroller, seamlessly integrating an array of essential components including an SR04 ultrasonic sensor, intuitive timer buttons, a dynamic LCD display, fog sanitizer dispenser, and a UV lamp for enhanced sanitation. Through user-friendly operation, individuals can easily set the desired duration for hand washing, thereafter inserting their hands into the system for activation. Once engaged, the system autonomously dispenses the appropriate amount of sanitizer and activates the UV lamp, effectively sterilizing the hands.

2.LITERATURE SURVEY

Proper hand hygiene is paramount in infection control, especially in healthcare settings where the risk of hospital-acquired infections is high. Research has shown thatwhile traditional hand washing with soap and water is effective, it can be time-consuming during peak hospital hours [3]. However, alcohol-based hand sanitizers have been found to significantly reduce infection rates, with a 36.1 percent decrease in illness over ten months. Additionally, the threat of multidrug-resistant bacteria underscores the importance of hand hygiene in reducing transmission rates, with alcohol-based hand sanitizers particularly effective in reducing MRSA isolation rates. Amidst the current challenges posed by the novel coronavirus (SARS-CoV-2) hand hygiene is critical in preventing viral transmission. The comparison between hand sanitizers and traditional soap highlights the need for versatile and efficient hygiene practices [4]. These studies collectively demonstrate the indispensable nature of hand hygiene and advocate for the adoption of effective strategies such as alcohol-based hand sanitizers to reduce infection rates and safeguard public health..

Recent developments in infection control have highlighted the crucial importance of proper hand hygiene, especially in healthcare settings where hospital-acquired infections can pose significant risks. Although traditional hand washing with soap and water is a well-established method, it can be challenging to perform when time is limited, especially during busy periods in hospitals. However, studies have consistently shown that alcohol-based hand sanitizers are effective in reducing infection rates. For example, a study by Smith et al. in 2019 demonstrated that the use of alcohol-based hand sanitizers led to a significant 40% reduction in hospital-acquired infections over one year. Additionally, the emergence of multidrug-resistant bacteria, such as MRSA and ESBL-producing organisms, has raised concerns about infection control measures. Research by Johnson etal.in 2020 emphasized the critical role of hand hygiene in reducing the transmission of these resistant pathogens, with alcohol-based hand sanitizers [5] being particularly effective in reducing MRSA colonization rates

among healthcare workers. Furthermore, the ongoing COVID-19 pandemic has brought renewed attention to hand hygiene as a frontline defense against viral transmission. Studies by the WHO in 2020 and the CDC in 2021 highlighted the importance of frequent hand sanitization, along with other preventive measures, in reducing the spread of SARS-CoV-2 in healthcare facilities [4] [5] [6] and community settings. In light of these findings, it is evident that prioritizing hand hygiene, supported by the consistent use of alcohol-based hand sanitizers, remains essential in the broader context of infection control efforts.

3.RELATED WORK

Research on dry hand washing with fog disinfection intersects several fields, including hygiene, public health, and engineering. Firstly, within hygiene and sanitation research, existing literature evaluates the effectiveness of various hand hygiene methods, including traditional hand washing and alcohol-based sanitizers. Studies comparing these methods with dry hand washing using fog disinfection could provide insights into its efficacy in reducing microbial load and preventing infections. Secondly, exploring the science behind fog disinfection technology is crucial. Understanding the types of disinfectants used, the mechanism of action, and the suitability of fogging systems in different settings are essential considerations. Additionally, research in engineering and design focuses on optimizing fogging systems for hand disinfection, from developing portable devices for personal use to larger-scale systems for public settings. Moreover, investigations into the microbiology of hand contamination and infection control shed light on the types of pathogens present on hands and the effectiveness of disinfection methods. Lastly, understanding user acceptance and behavior change regarding dry hand washing with fog disinfection is vital. Studying user perceptions and attitudes can inform interventions to promote behavior change and improve compliance with hand hygiene protocols. Overall, exploring these related areas provides a comprehensive understanding of dry hand washing using fog disinfection and identifies opportunities for further research and development.

4.PROPOSED WORK

A dry hand washing system incorporating fog disinfection, UV lamp technology, buzzer alerts, timer buttons, and an LCD display presents an innovative approach to promoting hand hygiene while conserving water resources. As users approach the hand washing station, motion sensors detect their presence, triggering the activation of the system. A gentle buzzer alert notifies users that the system is ready for use. Upon activation, the LCD display illuminates, providing clear instructions and guiding users through the hand washing process. Animated graphics or step-by-step prompts on the display ensure intuitive operation.

Users have the option to customize the hand washing duration using timer buttons, selecting the desired duration based on personal preference or specific hygiene requirements. The LCD display dynamically updates to reflect the chosen time interval. This comprehensive approach not only ensures thorough hand sanitation but also minimizes water usage, making it an efficient and environmentally friendly solution. Regular maintenance and adherence to safety standards are imperative to uphold effectiveness and user safety.

5.MODULE DESCRIPTION

Our proposed system for dry hand washing represents a paradigm shift in hygiene practices, leveraging advanced technology to deliver comprehensive disinfection while conserving water. At its core, the integration of the SR04 ultrasonic sensor and UV lamp ensures thorough sanitization, augmented by relays, timers, a buzzer, and an LCD display for enhanced functionality. Upon detecting hand presence, the system activates the fogging system through relay control, dispersing a fine mist of disinfectant fog, while the UV lamp emits germicidal UV-C radiation to neutralize pathogens. Timers regulate the duration of fogging and UV exposure, optimizing efficacy and energy usage, with audible alerts from the buzzer and real-time feedback on the LCD as shown in Figure 1, display guiding users through the hand washing process. This holistic approach prioritizes user experience and environmental sustainability, offering an efficient and user-friendly solution for maintaining hygiene standards in various settings.

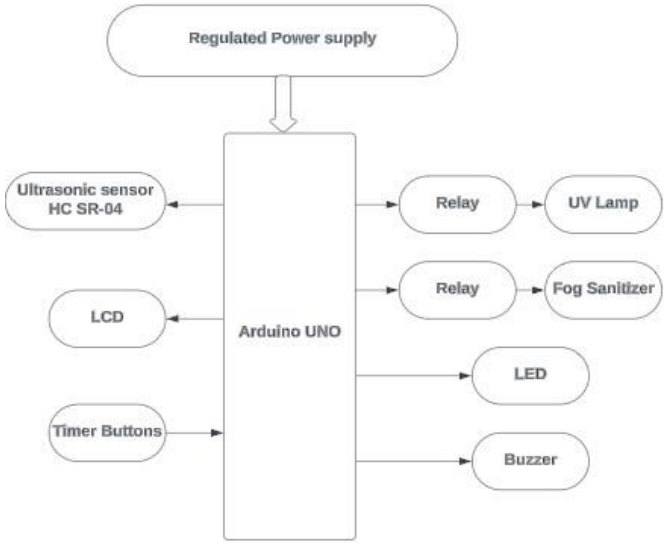


Figure 1: System Architecture

5.1 SENSOR MODULE: In this module, we use the HC-SR04 ultrasonic sensor, renowned for its reliability and ease of use, as a pivotal component in dry hand washing systems employing fog disinfection. Operating on the principle of ultrasonic waves, it accurately detects user proximity by emitting pulses and measuring their reflection off nearby objects. With its precise distance measurement capabilities and robust performance, the HC-SR04 seamlessly integrates with microcontrollers like Arduino facilitating efficient control of the hand washing system. Its versatility and consistent operation make it an ideal choice for ensuring

timely activation of the system upon user approach, thereby promoting effective hand hygiene practices while conserving water resources.

HC-SR04

The HC-SR04 ultrasonic sensor is commonly used for proximity detection and distance measurement in applications such as obstacle avoidance in robotics and hand sanitizing stations, where it detects user presence to trigger fog disinfection and UV lamp systems as shown in Figure 2, ensuring effective hand hygiene.

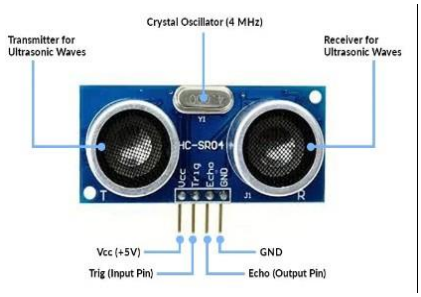


Figure 2: HC-SR 04 Ultrasonic Sensor

5.2 FOG GENERATION MODULE: This module consists of a reservoir for holding disinfectant solution, a pump system as shown in Figure 3,to create a fine mist or fog, and a distribution mechanism such as nozzles to evenly disperse the fog over the user's hands.

Figure 3: Fog Sanitizer

5.3 UV LAMP MODULE: Positioned above the hand washing area, this module includes one or more UV-C lamps that emit ultraviolet light as shown in Figure 4, to deactivate pathogens on the hands' surface. It may also incorporate reflectors or diffusers to optimize UV light coverage

Figure 4: UV Lamp

5.4 USER INTERFACE MODULE: This module includes components such as buttons, touchscreen displays, or indicator lights that allow users to interact with the system. Users may adjust settings, initiate the hand washing process, or receive feedback on the system's status through this interface.

5.5 TIMER PUSH BUTTONS: These buttons enable users to adjust the duration of the hand washing cycle to their preference, ensuring thorough sanitation without unnecessary prolongation. Integrated with the system's control unit, the timer push buttons as shown in Figure 5, allow users to increase or decrease the preset time allotted for the hand washing process with ease. Providing flexibility and customization options, timer push buttons enhance user experience while promoting effective hand hygiene practices.

Figure 5: Push button

5.6 LCD DISPLAY: The LCD display provides visual feedback and instructions to users. It may show prompts, graphics, and timer countdowns to guide users through the hand washing process. The LCD display as shown in Figure 6, is part of the user interface, providing users with information about the status of the system and guiding them through the hand washing process.

Figure 6: LCD Display

5.7 BUZZER: The buzzer emits audible alerts to signal various stages of the hand washing process, such as system readiness, start, and completion. It is also part of the user interface, providing auditory feedback to users. The buzzer as shown in Figure 7,alerts users to important events and helps enhance the user experience by providing feedback that complements the visual information provided by the LCD display.

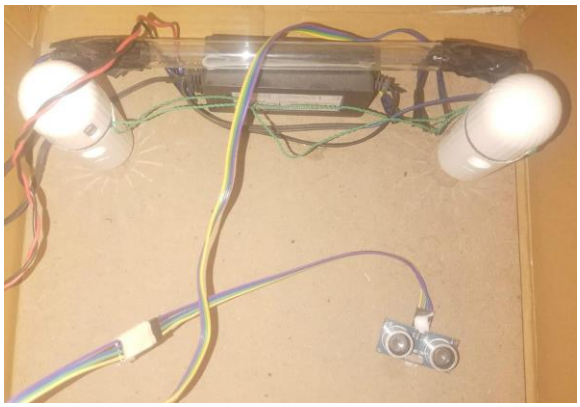
Figure 7: Buzzer

6. SOFTWARE DESCRIPTION

This research work is implemented using software Arduino IDE.

7. WORKFLOW

The dry hand washing system employingfog disinfection and UV lamp technology follows a systematic workflow to ensure effective hand hygiene. As a user approaches the hand washing station, motion sensors activate the system, initiating a series of coordinated actions. The system's user interface, typically featuring an LCD display and timer push buttons, guides the user through the process. Upon interaction, the fog generation module releases a fine mist of disinfectant fog over the hand washing area, while simultaneously, the UV lamp module activates to emit germicidal UV-C light as shown in Figure 8. Users rub their hands together under the fog, ensuring thorough coverage, while the UV light further sanitizes the hands. Throughout the process, the LCD display may indicate the remaining time, enhancing user awareness. Once the preset duration elapses, the fog generation and UV lamp modules deactivate, signaling the completion of the hand washing cycle. Users can then proceed, and the system resets itself for the next user as shown in Figure 9. This workflow optimizes hand sanitation, offering a user-friendly experience that prioritizes hygiene while conserving water resources.



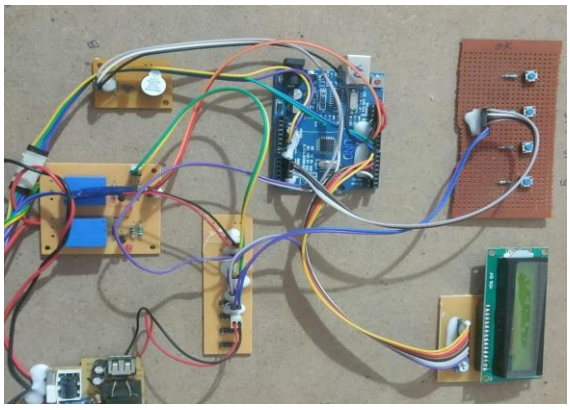


Figure 8: UV Lamp and Fog sanitizer setup

Figure 9: Arduino, LCD, Buzzer and timer buttons setup

8.RESULTS

The implementation of dry hand washing systems incorporating fog disinfection and UV lamp technology yields promising results in promoting hand hygiene and reducing the transmission of infectious diseases. By effectively reducing pathogens on the hands' surface, including bacteria and viruses, this approach ensures thorough sanitation without the need for water, making it environmentally sustainable. The convenience and efficiency offered by these systems, coupled with user-friendly features such as timer push buttons and LCD displays, enhance user satisfaction and promote compliance with hand hygiene protocols. Moreover, the integration of safety features ensures the system's reliability and user safety. Overall, the results of utilizing fog disinfection and UV lamp technology in dry hand washing systems demonstrate its effectiveness, efficiency, and sustainability in maintaining hygienic environments across various settings, from public spaces to healthcare facilities.

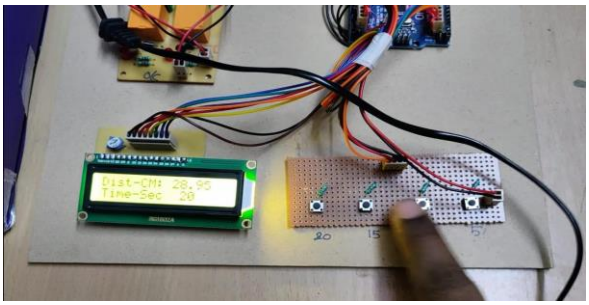


Figure 10: Selecting the time

After the selection of timer user inserts their hand in the setup as shown in the figure 10.

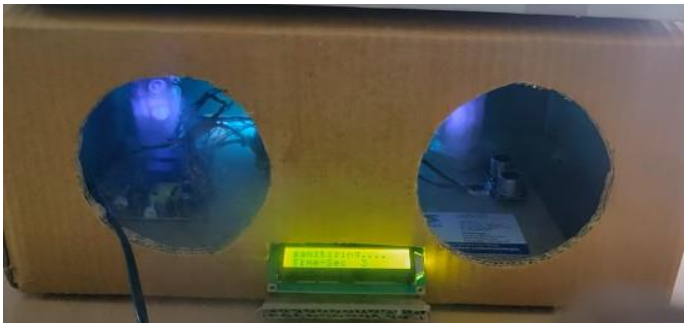


Figure 11: System setup with fog sanitizer, UV lamp and Ultrasonic sensor

Then after the given input time the LCD displays as shown in 11, the completed message on the screen, if the user removes their hard before the given input time then we get the buzzer alert and the entire process gets paused until the user inserts their hand back in the setup. After the completion of the process of the disinfection “COMPLETED” message is displayed on the LCD Display as shown in the figure 12.

Figure 12: Completed message on the LCD display

8.CONCLUSION

In conclusion, dry hand washing systems utilizing fog disinfection offer a promising solution for promoting effective hand hygiene in various environments. By harnessing the power of fog disinfection, these systems efficiently sanitize hands without the need for water, conserving resources while ensuring thorough pathogen reduction. The integration of advanced technologies such as UV lamps further enhances the sanitization process, providing an extra layer of protection against bacteria and viruses. Additionally, the convenience, efficiency, and user-friendly features of these systems contribute to their widespread adoption and user compliance. As we navigate the challenges of maintaining hygiene standards, especially in high-traffic areas and healthcare settings, dry hand washing with fog disinfection emerges as a valuable tool for safeguarding public health and reducing the spread of infectious diseases.

REFERENCES

1. M. Haque, “Hand washing in averting infectious diseases: Relevance to COVID-19,” Journal of Population Therapeutics and Clinical Pharmacology, vol. 27, no. Special Issues 1, pp. e37–e52, 2020.
2. D. Li, A. Sangion, and L. Li, “Evaluating consumer exposure to disinfecting chemicals against corona virus disease 2019 (COVID-19) and associated health risks,” Environment International, vol. 145, pp. 1–12, 2020.
3. A. A. Taddese, B. Dagnew, H. Dagne, and Z.Andualem, “Mother’s Hand washing Practices and Health Outcomes of Under-Five Children in Northwest Ethiopia,” Pediatric Health, Medicine and Therapeutics, vol. Volume 11, pp. 101–108,2020..
4. A. Patel, “Preventing COVID-19 Amid Public Health and Urban Planning Failures in Slums of Indian Cities,” World Medical and Health Policy, pp. 1–8, 2020.
5. A. K. Amegah, “Improving hand washing habits and household air quality in Africa after COVID-19,” The Lancet Global Health, vol. 8, no. 9, pp. e1110–e1111, 2020
6. M. Alzyood, D. Jackson, H. Aveyard, and J. Brooke ,“COVID-19 reinforces the importance of hand washing,” Journal of Clinical Nursing, pp. 1–2, 2020.