

Smart Automated Dry Hand Disinfection Machine

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Abstract — The Dry Hand Washing Machine by Fog Disinfection to Save Water presents an innovative, contactless, and water-free hygiene solution designed to improve public sanitation while conserving natural resources. The system utilizes sensor-based automation and fog disinfection technology to sanitize hands by dispersing a fine mist of disinfectant, eliminating the need for water and physical contact. This approach significantly reduces water consumption, minimizes the risk of cross-contamination, and ensures efficient germ control in high-traffic public environments. The machine operates automatically through a microcontroller-controlled mechanism that detects hand presence, activates the fog generator, and ensures uniform disinfection within a fixed time cycle. Experimental results demonstrate reliable performance, fast operation, and effective sanitation, making the system suitable for hospitals, educational institutions, public transport areas, and rural regions. The proposed solution offers a sustainable, eco-friendly, and cost-effective alternative to conventional handwashing systems, contributing to improved hygiene standards and environmental protection.

Keywords: Dry Hand Washing Machine; Fog Disinfection Technology; Contactless Sanitization; Water Conservation; Sensor-Based Automation; Sustainable Hygiene System.

I. INTRODUCTION

Maintaining proper hand hygiene is essential for preventing the spread of infectious diseases and ensuring public health safety. Traditional handwashing methods depend on water and physical contact with taps and dispensers, which leads to problems such as water wastage, infrastructure dependency, and cross-contamination risks. With increasing water scarcity and the need for contactless hygiene systems, there is a strong demand for alternative sanitation solutions. The Dry Hand Washing Machine by Fog Disinfection to Save Water introduces a modern, water-free approach to hand sanitation using fog disinfection technology. By generating a fine disinfectant mist, the system cleans and disinfects hands without using water, providing a hygienic, eco-friendly, and automated solution suitable for public and high-traffic environments.

II. LITERATURE REVIEW

A. Aim of the Project

The main aim of this project is to design and develop a waterless, contactless dry hand washing machine using fog disinfection technology that ensures effective hand hygiene while conserving water. The project focuses on creating an automated, eco-friendly, and cost-effective sanitation system that reduces the spread of infections, minimizes water wastage, and provides a sustainable alternative to traditional handwashing methods for public and high-traffic areas.

III. HARDWARE COMPONENTS

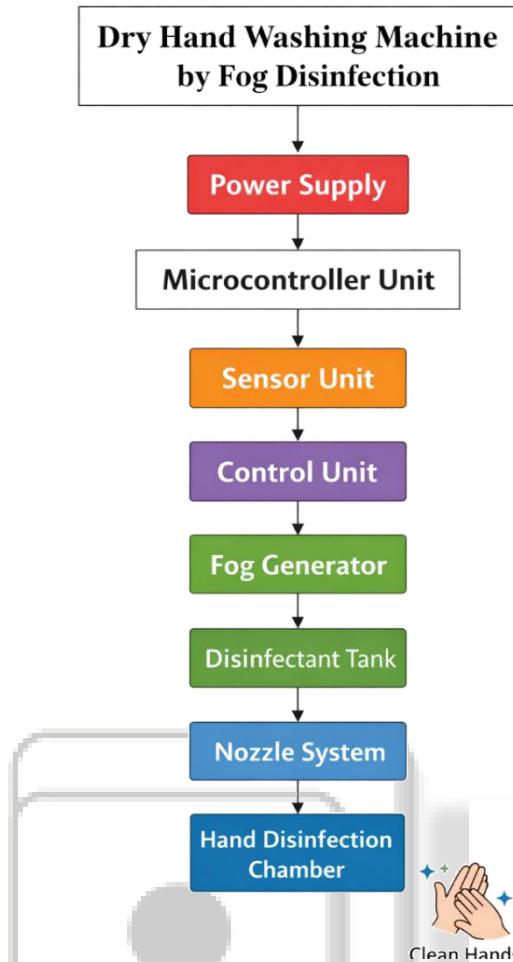
- Microcontroller (Arduino / ESP32)
- IR / Proximity Sensor
- Fog / Mist Generator Module
- Disinfectant Liquid Tank/ plastic bottle
- Relay Module
- Power Supply Unit
- Voltage Regulator
- Nozzle System
- Control Switches
- LED Indicators
- Wires and Connectors

IV. WORKING PRINCIPLE

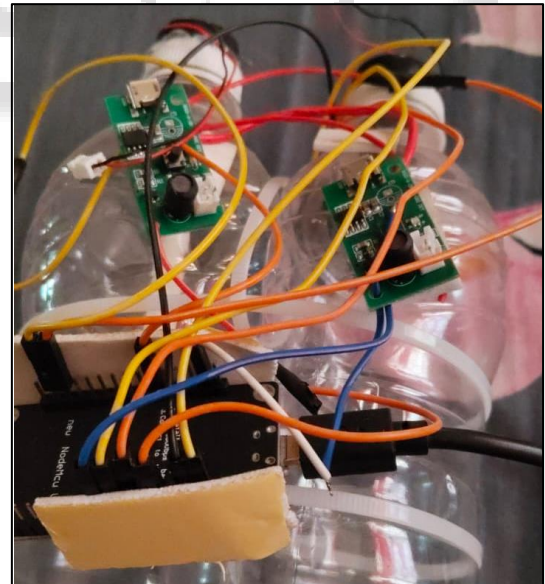
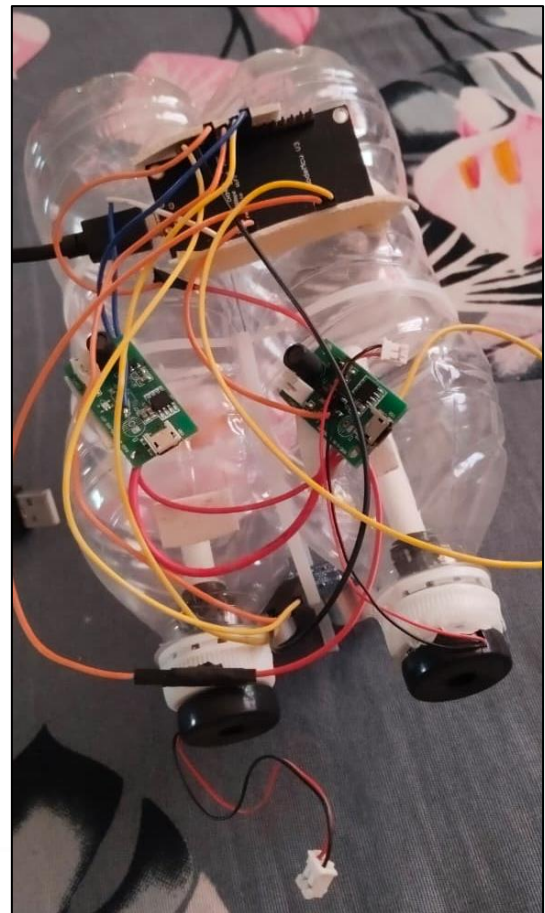
The working of the Dry Hand Washing Machine is based on sensor detection and automated fog disinfection. When a user places their hands inside the machine, the IR/proximity sensor detects their presence. Various studies and existing systems have focused on improving hand hygiene through touchless technologies such as automatic sanitizer dispensers, UV-based disinfection systems, and mist/fog sanitation devices. Fog disinfection technology has been widely used in hospitals, laboratories, and industrial environments for surface and air sterilization due to its ability to distribute disinfectant particles uniformly. Research on sensor-based automation and embedded systems has enabled the development of contactless hygiene devices that reduce human interaction and contamination risks. However, most existing systems either rely on liquid sanitizers, water-based cleaning, or expensive infrastructure. This project builds on these technologies by integrating fog disinfection, sensor automation, and embedded control into a single, compact, and water-free hand sanitation system, offering an efficient and affordable solution for large-scale public use.

and sends a signal to the microcontroller. The controller processes this signal and activates the relay module, which turns ON the fog generator. The fog generator converts the disinfectant liquid into a fine mist (fog) and releases it through the nozzle system. This fog spreads uniformly around the hands and disinfects them by killing germs and bacteria. After a fixed time interval, the microcontroller automatically switches OFF the fog generator. The system then resets and becomes ready for the next user. This process ensures water-free, touchless, and automatic hand sanitation.

V. BLOCK DIAGRAM WITH EXPLANATION



- 1) Power Supply: Provides electrical power to the entire system, including sensors, microcontroller, and fog generator.
- 2) Microcontroller: Controls the system logic, timing, and automation. It processes sensor signals and controls the fog generator.
- 3) Sensor Unit:L Detects the presence of hands and sends input signals to the microcontroller.
- 4) Control Unit (Relay Module): Acts as a switching device that safely controls the fog generator based on microcontroller commands.
- 5) Fog Generator: Converts liquid disinfectant into fine fog particles for effective disinfection.
- 6) Disinfectant Tank: Stores the disinfectant liquid required for fog generation.
- 7) Nozzle System: Distributes the fog uniformly around the hands.
- 8) Hand Disinfection Chamber: The enclosed area where hands are placed and fog disinfection takes place.
- 9) Output (Clean Hands): Final result of the system where hands are disinfected without using water.
- 10) Circuit Diagram



VI. ADVANTAGES

The Dry Hand Washing Machine by Fog Disinfection to Save Water offers a water-free, touchless, and eco-friendly method of hand sanitation. It helps in saving water, reducing the spread of germs, and improving hygiene standards in public places. The system is fast, automatic, energy efficient, and easy to use, making it a cost-effective and sustainable solution for modern hygiene needs.

VII. FUTURE SCOPE

- Solar Power Integration: The system can be operated using solar energy to reduce electricity dependency and make it suitable for rural and remote areas.
- IoT Monitoring: Internet of Things technology can be added to monitor usage, disinfectant level, and machine health remotely.
- Mobile Application Control: A mobile app can be developed for system control, status checking, and maintenance alerts.
- Battery Backup System: Backup power can ensure continuous operation during power failures.
- Smart City Integration: The system can be connected with smart city infrastructure for public hygiene management.
- AI-Based Hand Detection: Artificial intelligence can improve hand detection accuracy and fog control.
- Smart Fog Control: Advanced control systems can optimize the amount of fog to reduce chemical wastage.

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