International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Surface Disinfection Robot

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Abstract - The Surface Disinfection Robot project utilizes sophisticated technology to automate the cleaning and disinfection of floors in various spaces. The robot is equipped with an ultrasonic sensor to detect obstacles, allowing it to navigate and change directions in order to avoid colliding with whatever is in its path while surveying the entire space. Two DC motors are utilized for vehicle movement; one motor powers the vehicle to drive the robot in a forward manner while the other is used to power the device that cleans the floor. The cleaning of the floor is completed by utilizing a mopping system that allows for clean and sanitized floors for all surfaces. UV LEDs are installed to disinfect the surfaces on the floor in addition to cleaning and sanitizing with the mop. The whole system is consistently tracked, monitored, and controlled with Adafruit IoT; therefore, providing the user with remote accessibility for both operation and status viewing of the area being cleaned. This intelligent robot is fully autonomous, and will help up to create cleaner and safer home and office environments by automating disinfection and cleaning for private and commercial spaces with minimal human intervention, creating a cleaner and safer environment.

Keywords Autonomous Robot UV-C Sanitization IoT-based Disinfection

1.INTRODUCTION As of recent years, with heightened awareness about hygiene and sanitation, the demand for automated solutions to assist with cleaning has accelerated. The Surface Disinfection Robot has been developed to assist with floor cleaning and disinfection in both residential and commercial environments, allowing for minimal human involvement while maintaining appropriate sanitation. This intelligent robotic solution contains several advanced technologies to navigate the environment and disinfect surfaces as needed. The device has an ultrasonic sensor that detects obstacles, enabling the robot to continue moving without colliding with obstacles while covering the entire floor. The movement parameter consists of two DC motors, one for movement and another for a mop unit, to ensure a thorough cleaning. Cleaning is enhanced with multiple UV LEDs to disinfect surfaces, providing additional protection against harmful microorganisms**.**

2.LITERATURE SURVEY:

1 UV-C (200-280 nm) can kill microorganisms by breaking DNA/RNA. The following are examples: Xenex LightStrike Robot – A robot used in hospitals to disinfect a room quickly.UVD Robots – Autonomous UV-C robots designed for routine use in health care settings. Research Study: Research shows that UV-C exposure of 10–15 minutes can kill up to 99.99% of bacteria and viruses on surfaces.

2 Apply disinfectant sprays or fogging systems to disinfect surfaces. Examples Health guard - Uses a mist disinfection system. Fogging Robots - Deliver a disinfectant mist to disinfect large areas. 🛠️ Hybrid Robots (UV Chemical Mopping) Some robots use a hybrid of various cleaning strategies to improve efficiency. Examples published in the International Journal of Intelligent Robotics reports the development of a hybrid UV and mopping robot that achieved 99.7% disinfect efficiency, in a hospital corridor. 🚨 IoT & AI-Powered Disinfecting Robots Sensors & AI Algorithms may optimize patterns of cleaning. IoT control systems may enable access for remote operation and monitoring examples mentioned in a research article in Sensors and Actuators B, reported a disinfection robot that had real-time cloud monitoring utilizing IoT platforms such as Adafruit and MQTT.

3 Research Gaps & Future Work Challenges with Existing Systems: Limited Autonomy: A large number of robots still rely on robot autonomy with pre-programmed paths instead of full AI-based navigation. UV-C Safety: Exposure to humans can be dangerous since UV-C is harmful, thus protocols must be designed to limit exposure. Battery Life: High-power UV lamps cause batteries degrade in a short duration. Future Research Directions: AI-Based Real-time Mapping (SLAM, LiDAR) Hybrid Disinfection Systems (UV and Disinfectant Spray) Energy Efficient UV-C Technologies

(prolong battery life) Human-Safe UV-C Operation with Automated UV shielding.

3.PROPOSED METHODOLOGY:

Feasibility Study Establish the demand for automated disinfection in auxiliary spaces (community and private) and set the goals of the system, (for instance, coverage, pace and safety). System development Create a mobile robot by specifying major components such as a wheel and motor system, variety of sensors, and a disinfection system (UV-C lamps or chemical sprayers). Sensor Integration Incorporate sensors using various approaches (ultrasonic, IR or LIDAR) to detect, avoid and navigate obstacles or hazards. Control System Use a microcontroller technology (such as Arduino or Raspberry Pi) to drive movement, control the disinfection process, and ensure safety. Software Development Develop integrated and/or sequential software algorithms to allow autonomous movement, surface detection, and safe disinfection operation. Prototype and Testing Prototype and test the robot in real-world environments, demonstrate disinfection and evaluate the effectiveness of the process, and adjust and develop better build and movement capabilities.

3.1 Block Diagram

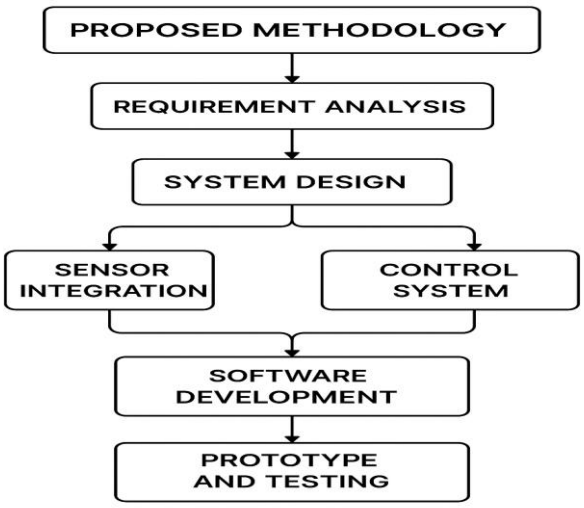
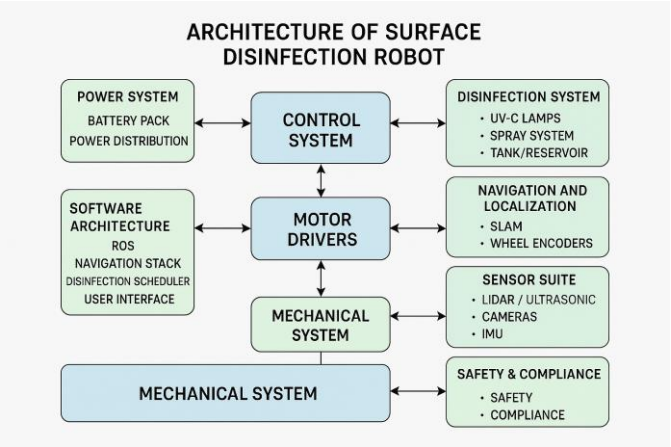


Figure 1: Block Diagram

1. Requirement Analysis Goals: Outline the objectives for disinfection automation. Includes: Determining the location (e.g., hospitals, malls), determining robot size, determining coverage area, determining safety features, etc.2. System Design Goals: Design the physical and functional shape of the robot. Features: Chassis: Robot structure and wheelchair structure. Disinfection Unit: UV-C lights or chemical sprayer. Wheels & Motors: A moving system that drives the robot. 3. Sensor Integration Goals: Allow the robot to detect obstacles and surfaces. Common Sensors: Ultrasonic/IR Sensors: Sense objects and keep a safety distance. LIDAR/cameras: For more advanced mapping and navigation (optional). 4. Control System Goals: Control all processes of the robot. Main Component: microcontroller (e.g., Arduino, Raspberry Pi). Activities: Control motors, check sensors, disinfect, etc. 5. Software Development Goals: Create logic and automation. Includes: Navigation behavior planning Disinfection behaviourSafety features (e.g., auto shut off when human detected) 6. Prototype and Testing Goals: Build the system and evaluate. Includes: Assemble hardware. Test movement, area of cover, disinfection, etc. Tweak settings based on observations.

1.2 ARCHITECTURE OF THE SYSTEM



RESULT: The Surface Disinfection Robot is an autonomous, mobile robot intended to disinfect surfaces for viruses and bacteria using either UV-C light or a chemical spray. It autonomously navigates indoor environments relying on a combination of sensors and mapping/fusion algorithms (like SLAM). It detects obstacles and humans features the ability to only spray or disinfect in known safe areas. The robot reduces the likelihood of transmission of viruses and bacteria in a variety of public settings, including hospitals, schools, and businesses. The purpose of the robot is to assist with hygiene protocols, relieve staff from manual labor, and provide consistent disinfection of large areas**.**

Conclusion: The Surface Disinfection Robot is an efficient and automated method for maintaining clean surfaces in public and private environments. By integrating both autonomous navigation and UV-C, and/or spray disinfection, the robot can eliminate the manual process of surface disinfection and lower the risk

of exposure of a person to harmful pathogens. The meaning of the robot is more relevant even in high-risk areas such as hospitals, schools, and offices, by providing a smart, effective, and safe method for disinfecting surfaces**.**

FUTURE SCOPE: The Surface Disinfection Robot has tremendous potential for future development, which may include: - AI Integration for intelligent path planning and adapting disinfection based on real-time data. - Cloud Connectivity for remote monitoring, analytics and scheduling tasks. - Voice Control and App Control for better human interaction. - Multi-Robot Coordination for covering larger areas in a more effective way. - Advanced Sensors for better human detection and environmental mapping. - Outdoor Capability to disinfect public spaces, transit spaces, and streets.

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