

# Smart Toilet Automation System

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**Abstract—** In numerous parts of India and slums, public sanitation remains distressingly insufficient, marked by frequent urination and overflow due to poorly maintained or unsanitary public restrooms. Despite significant expenditure and efforts by governments to maintain cleanliness in these facilities, the lack of a centralized monitoring mechanism renders these endeavors futile. The absence of such oversight perpetuates unhygienic conditions and exacerbates pollution issues. To address this pressing concern, the implementation of an automatic restroom cleaning system in all public restrooms, coupled with a cleaner connection, could prove instrumental in alleviating pollution problems. The primary objective of this project is to demonstrate the functionality of smart restroom management systems, leveraging advanced technology such as controllers and detectors. This innovative approach empowers both restroom cleaners and administrators to monitor various cleaning metrics and receive real-time updates on restroom conditions based on user feedback. By integrating technology into sanitation management, this project endeavors to enhance cleanliness and hygiene standards in public facilities, thereby contributing to the overall well-being of communities.

**Index Terms—** Smart Restroom, Hygiene, Auto-Flush, Solar Powered, Water Conservation, Automation etc.

## I. INTRODUCTION

Based on UNICEF data, India grapples with the highest rate of human waste exposure, with an estimated 625 million people lacking access to restrooms. This dire situation has led to a surge in public health issues. Despite initiatives like the Swachh Bharat Mission Urban, which has facilitated the establishment of over 5.1 lakh functional restrooms and numerous reconstructed ones, approximately half of India's population still relies on open defecation. Shockingly, between 43% to 58% of rural individuals, including

children as young as two years old, resort to open defecation.

Despite the availability of numerous public restrooms, there's a glaring absence of mechanisms to monitor and maintain their cleanliness. The lack of oversight results in unhygienic conditions and poses significant health risks to the public. To address this challenge, our research proposes the implementation of an IoT system to comprehensively monitor various aspects of restroom maintenance, such as air quality, water availability, closures, and occupancy status. This system would utilize a user-friendly web interface for centralized data visualization, allowing for real-time monitoring and alerting authorities if cleanliness standards are not met.

The IoT system we propose presents a cost-effective solution that requires minimal resources for maintenance. Its versatility allows deployment in various environments such as residences, educational institutions, healthcare facilities, and industrial settings, thereby contributing to urban sanitation endeavors. Through its simplified approach to restroom monitoring and upkeep, the system endeavors to address current obstacles and promote enhanced cleanliness levels within public amenities.

## II. LITERATURE SURVEY

Abhimanyu kumar, Anshu Taunk:

The study focuses on evaluating the sanitation conditions of lavatories in both primary and secondary schools situated in rural areas of Uttarakhand. Data collection involved examining multiple facets including restroom utilization, maintenance protocols, operational effectiveness, hygiene standards, and construction methodologies utilized. Findings

indicated that 95% of primary schools and 97.18% of secondary schools were equipped with restroom facilities. Remarkably, the analysis highlighted that sanitation standards in secondary schools exceeded those in primary schools, emphasizing the necessity for collaborative endeavors across various societal domains to elevate sanitation conditions moving forward.

Adithya Bharadwaj, Arun Kumar, R. Balasubramanian, P. Gowtham:

This article introduces a proposal designed to maintain sanitary and hygienic standards while providing a convenient and efficient method for cleaning public restrooms. The cleaning procedure is entirely automated and consumes minimal power, facilitated by the utilization of an RFID module to initiate the flushing process, a line follower device to guide the robot, and a counter to monitor usage frequency. Moreover, the module incorporates a robotic arm capable of thoroughly cleaning the restroom area.

Margaret Quinn, Paul Henneberger, Alicia Stephens: Infection prevention, control, and occupational health and safety are critical topics for professionals, workers, researchers and policy makers across various healthcare settings, including hospitals, long-term care facilities, and home healthcare. This article provides a multidisciplinary overview of current knowledge and identifies potential gaps that could impact these stakeholders. It examines the benefits and risk associated with cleaning and disinfecting surfaces in both environmental settings and patient care items.

### III. PROBLEM FORMULATION

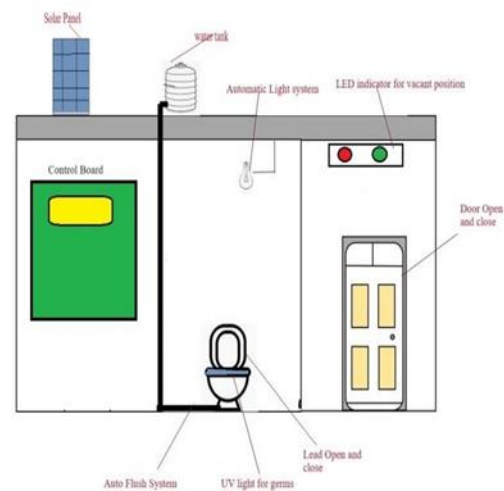
Traditional restroom facilities often feature manual flushing mechanisms, requiring users to interact with physical buttons or levers to initiate restroom flushing. While prevalent, this approach poses numerous limitations and challenges:

- Hygiene Concerns:** Manual flushing necessitates direct contact with buttons or levers, heightening the risk of cross-contamination and germ transmission in busy restroom environments. This compromises overall restroom hygiene and can pose health risks to users.
- Water Wastage:** Manual flushing systems lack flexibility in response to user behavior and waste

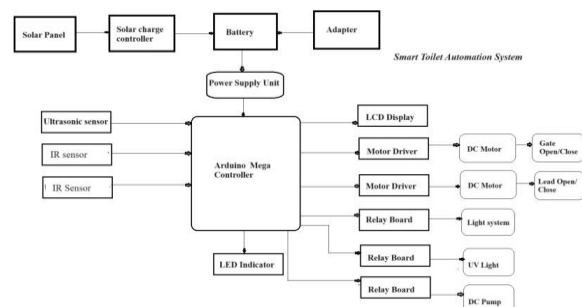
volume variations. Consequently, restrooms often consume a fixed amount of water per flush, irrespective of actual waste disposal needs, leading to inefficient water usage and unnecessary wastage.

- User Inconvenience:** Many users find manual flushing mechanisms inconvenient, particularly when cleanliness is a priority. Interacting with potentially unhygienic surfaces or encountering faulty mechanisms can result in a subpar restroom experience.
- Maintenance Challenges:** Facility managers encounter difficulties in tracking restroom usage patterns, identifying maintenance requirements, and optimizing cleaning schedules. Reactive maintenance practices may lead to inefficient resource allocation and compromised restroom conditions.

### IV. PROPOSED SYSTEM

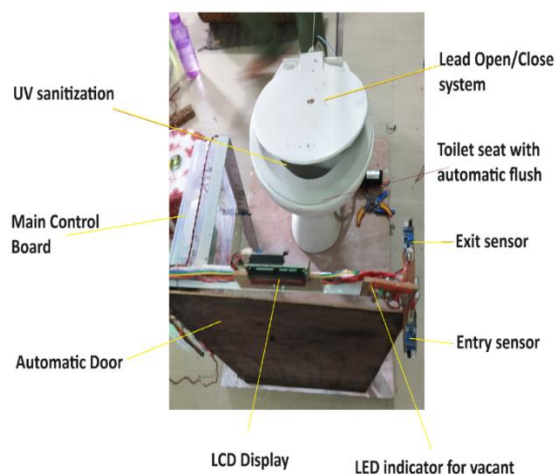


### V. BLOCK DIAGRAM



- The Arduino Uno functions as the central interface for controlling the components and detecting inputs and outputs. Positioned at the front of the restroom, an ultrasonic detector detects the presence of a person. If a seat is available, it triggers the door-opening mechanism, which is indicated by an LED indicator.
- Infrared (IR) detectors are utilized to detect human presence within the restroom, simultaneously triggering the activation of the lighting system.
- The ultrasonic detector detects when a person approaches the restroom seat, automatically opening the lid.
- Once the person moves away from the restroom seat, the lid closes, and the automatic flush and UV light systems activate to sanitize the seat.
- Upon exiting, another detector detects the person's presence, prompting the gate to open, while all lighting systems deactivate automatically.
- These detectors operate by detecting presence over a specific duration, generating corresponding values transmitted to the controller for processing.
- The controller, programmed to receive data from the detectors, evaluates two conditions: the presence of a human and the purposeful use of the restroom.
- Solar energy, harnessed via solar panels, fulfills all power requirements. Light energy is converted into electrical energy, stored in batteries, and subsequently utilized for automation purposes.

## VI. IMPLEMENTED HARDWARE



## VII. RESULT AND DISCUSSION

This system addresses the prevalent issue of poorly maintained public restrooms by effectively tracking the activities of cleaning personnel, thus enabling higher authorities to maintain cleanliness in real-time. By enhancing labor efficiency and reducing extra costs, this system ensures that public restrooms are regularly cleaned, leading to increased usage by the general public. To further develop this system, additional mechatronic elements can be integrated to automate the cleaning process based on detector outputs.

Many individuals avoid using public restrooms due to concerns about hygiene. Our project aimed to address this issue by improving the sanitary conditions of public restrooms, culminating in a functional prototype. Throughout this project, we gained valuable insights into various project aspects, utilizing Arduino for its programming simplicity. We opted for PIR detectors over IR detectors for their extended detection range and enhanced precision. Moving forward, we envision a world with improved hygiene and reduced disease transmission, with potential enhancements such as UV light disinfection, peristaltic pump-assisted cleaning, insect-repelling circuits, and activated carbon odor reduction methods.

## CONCLUSION

The initiative has successfully achieved its objective of establishing a cost-effective and user-friendly interface between cleaning companies and public restrooms, simplifying staffing processes. The implementation of this program is uncomplicated, with the option to utilize time series predictions for ongoing assessments of restroom conditions. Through proactive measures, the system contributes to maintaining cleanliness and preventing restrooms from deteriorating into unsanitary conditions. Furthermore, enhancements to the mobile application's data display improve the user experience, making it more intuitive and user-centered. Overall, the integration of Internet of Things devices in this system proves to be both economical and portable, offering a practical solution to managing public restroom hygiene.

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