# AUTONOMOUS TOILET CLEANING ROBOT

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**Abstract:** This study suggests an inventive way to deal with the problem of keeping restrooms clean: creating an Internet of Things (IoT)-based automatic restroom cleaning robot with a gas sensor. Traditional restroom cleaning methods are often inefficient and labor - intensive, leading to inconsistent hygiene standards. By integrating IoT technology and a gas sensor into a robotic platform, this project aims to automate the cleaning process while also ensuring optimal air quality within the restroom environment. The robot will be capable of autonomously navigating through restroom spaces, detecting and removing dirt and debris, and identifying and neutralizing unpleasant odors using the gas sensor. Through real-time data monitoring and analysis, facility managers can remotely supervise the cleaning process, receive alerts for maintenance needs, and track cleanliness metrics, thereby enhancing efficiency, hygiene, and overall user satisfaction. There is a growing need for autonomous cleaning robots as a result of the growth of smart settings and residences. With the help of sensors to identify impediments and clean specific areas, the robot will be programmed to operate autonomously inside a predetermined region. The robot will be able to detect and react to the presence of particular gases, maybe including hazardous contaminants or disagreeable smells, thanks to the embedded gas sensor. Users can monitor the quality of the air and start specific cleaning chores by using this real-time data that can be sent via Internet of Things protocols to a central hub or smartphone application. With its intelligent and automated approach that encourages cleanliness and a healthier interior environment, the suggested system has the potential to completely transform home cleaning.

**Keywords:** Autonomous Robot, Toilet Cleaning, Sensor Fusion, Intelligent Control, Hygiene Maintenance.

## 1. INTRODUCTION

For years, cleaning the toilet has remained a chore dreaded by many. But what if there was a little robot that could handle this task efficiently and autonomously. Introducing the Autonomous Toilet Cleaning Robot (ATCR), a technological marvel poised to transform bathroom sanitation. The ATCR is a self-contained robotic unit designed to fit comfortably within most standard toilets. Its understated and elegant form makes it simple to incorporate into already-existing bathrooms without compromising style. For decades, robotic vacuum cleaners have revolutionized floor care, transforming tedious chores into automated routines. However, advancements in sensor technology are poised to usher in a new era of intelligent cleaning. This introduction explores the integration of gas sensors into cleaning robots, highlighting the potential for a more comprehensive, responsive, and user-friendly cleaning experience. Traditional robotic cleaners primarily rely on obstacle detection sensors and dirt sensors to navigate and clean effectively. Although these sensors are essential for basic operations, they are not able to identify and deal with pollutants and airborne contaminants. Envision a society where public restrooms are kept hygienically clean and don't require continuous manual cleaning. With the use of gas sensor technology and the Internet of Things, this vision can be achieved with an autonomous toilet cleaning robot (Internet of Things). This clever robot would have a gas sensor that could measure the amount and presence of ammonia, which is frequently used as a sign of bathroom activity. When the robot is connected to the Internet of Things, it may relay the cleaning requirements in real time to a central hub. This makes cleaning schedules more effective and guarantees that restrooms stay clean and fresh all day. Imagine a world where public restrooms are hygienically maintained without the need for constant manual cleaning. This vision can be realized with an autonomous toilet cleaning robot utilizing gas sensor technology and the power of IoT (Internet of Things). This innovative robot would be equipped with a gas sensor capable of detecting the presence and level of ammonia, a common indicator of restroom usage. Integrated with IoT, the robot would be able to communicate real-time cleaning needs to a central hub. This allows for efficient cleaning schedules, ensuring restrooms remain fresh and sanitary throughout the day.

Numerous advantages are provided by this autonomous system. It first frees up cleaning professionals to work on other projects by lessening their workload. Furthermore, by adjusting cleaning according to real-time usage, the robot maintains a constant high standard of hygiene, reducing the possibility of germ and odor spread. Additionally, the IoT integration allows for remote monitoring and maintenance of the robot, optimizing its operation and ensuring long-term functionality. This fusion of robotics, gas sensor technology, and IoT paves the way for a cleaner and more pleasant public restroom experience.

## 2. LITERATURE SURVEY

**1. VISUAL DIRT DETECTION FOR AUTONOMOUS CLEANING ROBOTS (Joseph Schmidt, Jiawen Xu, Richard Bormann, Xinjie Wang)** - In order to maximize the results of their wet cleaning and to enable demand-driven daily vacuuming, visual dirt detection is increasingly becoming a crucial feature of contemporary professional cleaning robots. For these objectives, a robust, quick, and accurate dirt and office item detection system based on an adjusted YOLOv3 architecture is presented in this study. Numerous tests show that it is superior to the most advanced dirt detection technologies available. A dataset generator is also included in the publication, which allows one to generate

an infinite number of realistic training photos from a limited amount of real scene, dirt, and item instances.

**2. OPERATION MODE DECISION OF INDOOR CLEANING ROBOT BASED ON CAUSAL REASONING AND ATTRIBUTE LEARNING (Yapeng Li , Donbo Zhang, Feng Yin, And Ying Zhang) -** Simple operation modes and low intelligence are now common flaws seen in cleaning robots on the market. This research suggests a decision-making process for the operation mode of cleaning robots in an effort to increase their level of intelligence and efficiency. Initially, extract garbage features like state, shape, distribution, size, and soon by utilizing the deep network's hierarchical expression capability. After that, by utilizing causal inference and joint learning of association attributes with depth network model, the causal relationship between the characteristics and the operation modes can be constructed. An operational mode choice fuzzy inference network is created based on this. A major simplification of the decision model's structure is achieved through causal analysis. In comparison to traditional fuzzy neural networks, the model's total parameters are decreased by a factor of two. This study presents a well-interpretable approach that mimics how humans dispose of various forms of waste. The experimental findings support the suggested method's efficacy.

**3. A SURVEY ON TECHNIQUES AND APPLICATIONS OF WINDOW-CLEANING ROBOTS (Zhenjing Li, Qingsong Xu and Lap Mou Tame) -** One crucial way to guarantee people's quality of life is to keep living and working spaces clean. The traditional method of window washing by human workers becomes riskier as building height grows, in addition to taking a long time. For such labor-intensive and hazardous tasks, robots must take the place of human workers. Numerous robots for cleaning windows have been used in real-world cleaning situations. This report presents the most recent state-of-the-art survey of robots that clean windows. The use of window-cleaning robots in two primary contexts—home use and high-rise building environments—as well as a summary of the related technical specifications are provided. The primary methods for developing window-cleaning robots, including as adhesion, cleaning, and movement processes, as well as sensor and controller units, are then thoroughly examined. The survey offers readers a resource to design and construct a robot that cleans windows for a particular purpose.

**4. AUTOMATION OF TRAIN CAB FRONT CLEANING WITH A ROBOT MANIPULATOR (Joao Moura, William Mccoll, Gerard Taykaldiranian, Tetsuo Tomiyama, and Mustafa Suphi Erden) -** Without the use of surface models or vision-based surface detection, we offer in this letter a control and trajectory tracking system for cleaning the front panels of train cabs. It involves a robotic manipulator driven by velocity and a force/torque sensor attached to its end effector. The control strategy consists of a simultaneous position and force controller that moves over the surface at the same time as it aligns the cleaning tool with the surface normal, maintaining a set-point normal force. This controller is adapted from the operational space formulation. The approach of trajectory tracking involves defining and monitoring a two-dimensional path that, when projected onto the train surface, aligns with the desired motion pattern. First, we used the Baxter robot to evaluate our method by using both a spiral and raster scan motion pattern to wipe a highly curved surface. Lastly, using a raster scan pattern, we applied the same methodology to a scaled robot prototype that we had specifically developed to towipea1/8scale railroad cab front. The approach presented in this research is easily interpreted and mimics how people discard various kinds of waste.

## 3. PROPOSED SYSTEM

Gas sensors and Internet of Things (IoT) technology can be used by an autonomous toilet cleaning robot to improve hygiene in both public and private restrooms. A gas sensor would be built inside the robot to identify the presence of methane or other gasses that indicate the accumulation of garbage. For real-time monitoring and control, this sensor data would be sent via the Internet of Things to a central hub. Upon detecting high gas levels, the robot would be programmed to navigate to the designated toilet stall and activate its cleaning mechanism. Once positioned, the robot would deploy its cleaning mechanism, equipped with disinfectant solutions, to automatically clean the toilet bowl and surrounding area. The robot would then communicate with the central hub to confirm completion and await further instructions. The most recent advances in robotic window washing are reviewed in this study, providing a state-of-the-art overview. A summary of the related technical requirements is provided, along with the uses of window-cleaning robots in two primary areas: high-rise building environments and home use. Through an IoT platform that can be accessed via a smartphone or tablet, the entire process, including cleaning completion and status updates, may be remotely monitored and controlled. IoT integration makes it possible to analyze sensor data remotely, optimize robot performance, and keep an eye on cleaning schedules. The time and effort normally spent on manual cleaning would be reduced by this technology, which would also improve hygiene.

## 3.BLOCK DIAGRAM

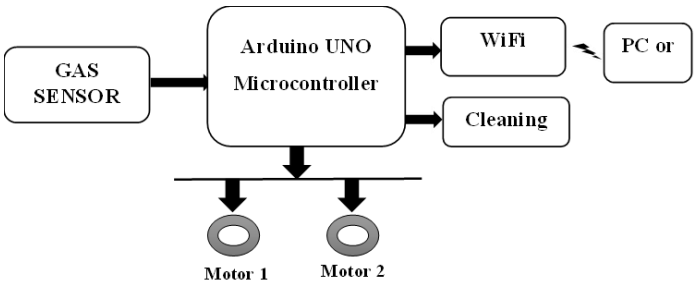



**Fig. 1**

## 4. COMPONENTS REQUIRED

| S/No | Component Used | Quantity |
|---|---|---|
| 1 | Arduino UNO | 1 |
| 2 | L293D Motor shield | 1 |
| 3 | Geared Motor | 4 |
| 4 | Li-power Rechargeable Battery 2200mAh - 11.1V | 1 |
| 5 | Switch/ Buttons | 1 |
| 6 | Ultrasonic sensor | 2 |
| 7 | Buck Converter | 1 |
| 8 | Wheels | 4 |
| 9 | Connecting Wires | - |

## 5. WORKFLOW

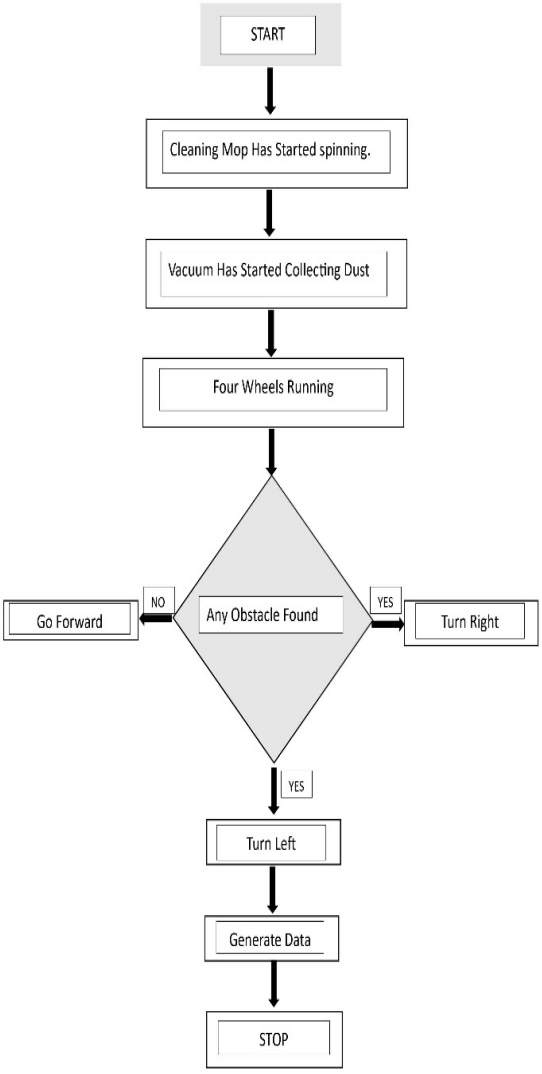
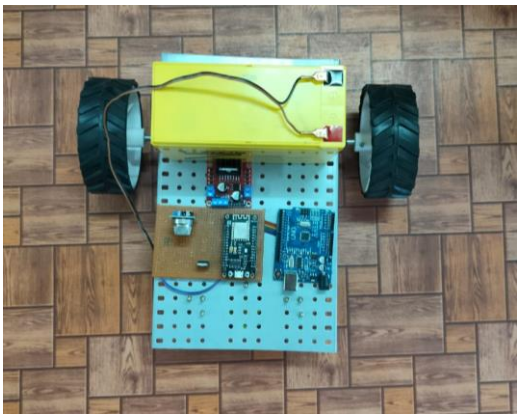



**Fig. 2**

## 6. RESULT AND DISCUSSION



The Autonomous Toilet Cleaning Robot is a cutting-edge solution revolutionizing restroom maintenance with its innovative features and advanced technology. This robotic system is equipped with essential tools such as brushes, water containers, and other necessary items for efficient cleaning. Controlled through a user-friendly web application interface, it offers unparalleled convenience and accessibility, allowing users to initiate cleaning cycles, monitor progress, and adjust settings remotely. What sets this robot apart is its precise movement and direction control, which allows it to navigate restroom environments with exceptional efficiency. Through the web application interface, users can define specific paths and cleaning routines tailored to the layout of the restroom. This customization ensures thorough coverage of all surfaces while optimizing sanitation efforts, leaving no area untouched. Furthermore, by lowering the need for harsh cleaning agents and conserving water, the autonomous toilet cleaning robot encourages sustainability and environmental responsibility. Its effective cleaning method not only saves resources but also helps to maintain restrooms in a more environmentally responsible manner. It provides an economical and ecologically responsible way to keep public and commercial spaces clean and hygienic by automating time-consuming operations and reducing the need for human interaction. The robot is still flexible enough to keep up with changing technology developments, even with the possibility of future updates to app-based controls. The online application may be further enhanced with the integration of additional features and functionalities, guaranteeing that it stays at the forefront of restroom maintenance technology. To sum up, autonomous toilet cleaning robots are a big step forward in the technology used to maintain restrooms.

Its versatile capabilities, user-friendly controls, and precise navigation make it an indispensable tool for public facilities and commercial establishments. By streamlining the cleaning process and promoting sustainability, it sets a new standard for cleanliness and hygiene, ensuring thorough sanitation with minimal human intervention.

## 7. CONCLUSION

An autonomous toilet cleaning robot utilizing gas sensor technology and IoT (Internet of Things) represents a significant advancement in restroom hygiene. This innovative system offers several compelling benefits. The gas sensor allows the robot to detect the presence of undesirable odors, triggering cleaning cycles only when necessary. This targeted approach optimizes efficiency and minimizes cleaning solution usage. Additionally, IoT integration enables remote monitor and control of the robot. Users can track cleaning schedules, receive real-time status updates, and even initiate cleaning cycles remotely. This level of automation ensures a consistently clean and hygienic restroom environment, reducing the workload on cleaning staff and improving public health. Overall, the autonomous toilet cleaning robot with gas sensor and IoT presents a promising solution for promoting cleanliness and enhancing user experience in restrooms.

## 8. FUTURE SCOPE

Cleaning robots of the future promise significant breakthroughs in restroom hygiene technology that will transform cleanliness and sanitation standards. As this technology develops, we expect major advancements that will improve performance, economy, and versatility in a range of settings. An impending development is the incorporation of technology such as UV disinfection, which will offer a supplementary level of sanitation in addition to customary cleaning techniques. Robotic cleaning skills can benefit greatly from the inclusion of UV disinfection, since it has demonstrated exceptional effectiveness in eliminating bacteria, viruses, and other harmful organisms. Robotic cleaners can attain a superior degree of hygiene by integrating UV disinfection technology, thereby fostering a more salubrious atmosphere for individuals using restrooms. Future cleaning robots should also have rechargeable batteries and automatic refill mechanisms for cleaning agents. Robots can now function with greater autonomy for longer periods of time without requiring human assistance. Robots that clean can maximize production and ensure uninterrupted cycles by optimizing their efficiency and effectiveness through autonomous management of necessary supplies and power levels. The incorporation of artificial intelligence (AI) into cleaning robots, which will allow them to modify cleaning schedules in response to usage trends and real-time sensor data, is another intriguing development. Robots equipped with artificial intelligence (AI) can assess environmental variables, like foot traffic and usage patterns, and adjust cleaning plans and schedules appropriately.
From homes to commercial and industrial facilities, cleaning robots will become indispensable tools, freeing up human workers for more complex tasks and contributing to a cleaner and healthier future.

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