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IOT based solution for Odor management in restrooms using sensors

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Abstract:
The Toilet Alert System is a cutting-edge Internet of Things (IOT) system that quickly detects and controls odors in real-time, revolutionizing the experience of using restrooms. This system continuously monitors the air quality in restrooms by utilizing cutting-edge sensors and sophisticated networking, with a primary focus on quick and accurate odor identification. The copious amounts of data that are gathered are sent to a central server via an easy-to-use interface, where advanced algorithms measure and evaluate the toilet environment. The fundamental aspect of this innovative solution is its capacity to enable people to make knowledgeable judgments regarding the use of restrooms. The companion mobile app is an essential resource that provides users with immediate access to relevant data on the levels of odor at any given time. With its easy-to-use UI and real-time cleanliness indications, the application lets users quickly assess the state of the restroom. In addition, the system uses sophisticated notifications to advise users when optimal conditions have been restored, guaranteeing a more comfortable and enjoyable toilet experience. The sophisticated sensors used in the Toilet Alert System help to provide a thorough evaluation of the entire lavatory environment in addition to detecting smells. This multipronged strategy improves the efficacy of the system in preserving ideal restroom conditions. The Toilet Alert System redefines toilet hygiene by seamlessly fusing state-of-the-art technology with user-friendly interfaces. It offers a solution that is both creative and useful in improving public sanitation experiences.

Keywords: Smart Restroom Management, IOT Sensors, Odor Detection, Real-time Monitoring, Smart Building Technologies.Introduction:

In a time when smart solutions are being incorporated into our daily lives and technology is advancing quickly, the "Toilet Alert System" stands out as a ground-breaking invention that has the potential to completely change how people use restrooms. Understanding how important it is to keep restrooms tidy and welcoming, this project makes use of Internet of Things (IOT) technology to present a complete and user-friendly solution. S. Surya and R. Ravi (2020) proposed that the simulation findings reveal that our suggested technique minimizes energy depletion and extends the sensor node's life time. By using high-quality monitoring mechanisms, the application of the suggested work aids in the monitoring of the structural health of buildings, bridges, and towers [1]. Matchava Rajyalakshmi,

P. Puthiya Selvi, B. Sabeena Bagam, and R. Ravi (2019) aims to build a reliable railway crack detection method employing an IR receiver sensor assembly system that prevents train accidents by detecting cracks on railway tracks. Additionally capable of locating itself using GPS and GSM modules, sending SMS messages to the authorities, and alerting them to the situation. Additionally, the system has a sensor for measuring distance, which displays the track deviation between the railroad tracks [2]. S. Surya and R. Ravi (2018) proposed that the fault tolerance mechanism, the energy consumption, and the lifetime of the sensor nodes be enhanced. The outcomes of the experiment highlight the benefits of implementing a fault tolerance mechanism [3]. According to U. Muthuraman, J. Monica Esther, R. Ravi, R. Kabilan, G. Prince Devaraj, and J. Zahariya Gabriel (2022) future data analysis will be based on statistics gathered with the aid of sensors and will be implemented as a webapp [4]. A. Shakeela Joy and R. Ravi (2021) proposed using metrics like detection rate, latency, and throughput for varied numbers of rounds to analyse ECC-based authentication schemes [5]. S. Raja Ratna and R. Ravi (2015) proposed that for a single jammer with a 0.1 attack probability, the throughput would increase to 0.36 mbps and the delay would drop to 2.1 seconds. Additionally, it can protect data even as the likelihood and volume of attacks rise [6]. According to A. Shakeela Joy and R. Ravi (2017) an enhanced endorsement method using elliptic curve cryptography offers higher security, confidentiality, and privacy. The technique is vulnerable to offline password guessing attacks including spidering, stolen-verifier, and keystroke dynamics [7]. In the context of smart building technologies, restrooms are sometimes disregarded, despite the fact that they are essential to user satisfaction and general hygiene. This essential component is addressed by the Toilet Alert System, which focuses on the real-time detection and control of restroom odors. Odors that are unpleasant to the senses have an effect on both user comfort and the general

impression of facility cleanliness. This system aims to close this gap by giving users access to real-time, relevant information about the current levels of odor in restrooms. A network of sophisticated sensors that have been thoughtfully positioned throughout restroom facilities forms the basis of this ground-breaking project. These odor-detecting and -quantitative sensors continuously monitor the quality of the air and send the information they collect to a central server. Through the use of complex algorithms, the system analyzes this data and provides real- time cleanliness indicators via a mobile application. People can use the user-friendly interface of the accompanying mobile application to make well-informed decisions about using the restroom. Real-time odor levels are easily accessed by users, offering a clear and proactive approach to restroom hygiene. This real-time feedback system guarantees a more enjoyable restroom experience by enabling people to select restrooms according to their preferences. The Toilet Alert System includes a strong management component in addition to features that are geared toward the user. When odor levels rise above predetermined thresholds, proactive alerts are sent to facility managers, allowing them to take prompt corrective action and expediting maintenance procedures. Furthermore, by providing feedback mechanisms, the system fosters user engagement and promotes a collaborative approach to ongoing restroom cleanliness improvement.As we set out on this mission to transform restroom management, the Toilet Alert System addresses a basic need of user satisfaction while also advancing smart building technologies. This project raises the bar for restroom experiences by skillfully fusing technology with a dedication to hygiene. It also moves us closer to a time when even the most basic places welcome innovation to improve people's daily lives.

Literature Survey:

Arduino: An Arduino board acts as the brains behind this Toilet Alert System project, coordinating the pairing of a Bluetooth module and a gas sensor. The air quality in the lavatory is continually measured by the Arduino through data reading from the gas sensor. If an offensive odor is detected, an algorithm analyses the gas concentration with a predetermined threshold and sounds a warning. Real-time monitoring and notifications are made possible by the Bluetooth module, which allows wireless communication between the Arduino and a smartphone app. The fast construction and testing of an intelligent lavatory monitoring system is made possible by an Arduino-based solution, which provides a flexible and portable platform for quick prototyping.

Breadboard: An essential part of the Toilet Alert System project is the breadboard, which connects different electronic components without the need for soldering and provides a platform for quick prototyping. The connections between the Arduino board, gas sensor, Bluetooth module, and power source are arranged in this configuration via the breadboard. It has holes arranged in linked rows and columns to make it easier to insert components and jumper wires. The distribution of VCC and GND connections is made simple by the power rails on the sides. Reusable and adaptable, the breadboard facilitates rapid alterations throughout the development stage, making it a vital tool for easily building and testing electrical circuits.

Gas Sensor: The gas sensor used in this project is an essential part of the air quality monitoring system for restrooms. Because of its dependability and efficiency, a gas sensor from the MQ series is usually used. This sensor is intended to identify a variety of gases, including those linked to disagreeable smells. It works on the basis of resistance shifting in response to different gas concentrations. The Arduino can measure the air quality in real time because the sensor produces analogue output. This gas sensor may be integrated with the Toilet Alert System so that the Arduino can detect and react to offensive smells. When the gas concentration rises beyond a set threshold, the Arduino will sound an alert, improving user experienceand lavatory hygiene.

Bluetooth: The Arduino microcontroller and the smartphone app in this project are able to communicate wirelessly thanks in large part to Bluetooth technology. The method enables smooth data transfer, enabling the Arduino to send real-time gas sensor values to the mobile app. It does this by using a Bluetooth module, like the HC-05 or HC-06. The user may remotely check the quality of the air in restrooms thanks to the Bluetooth module's dependable and secure connection. The project makes the Toilet alarm System adaptable and effective for odor monitoring and prompt facility management by utilizing this wireless link to provide user-friendly interaction, alarm alerts, and customization possibilities.

Algorithm for Odor Detection: This project's odor

detection algorithm measures the concentration of gases in the lavatory air by continually observing the signals from the gas sensor. Acceptable air quality is determined by a predetermined threshold. Real-time gas concentrations are compared to this threshold by the Arduino. The algorithm sends an alarm to the linked mobile app via the Bluetooth module if the measured concentration is higher than the predetermined limit. This guarantees that users are promptly notified when offensive smells are detected, enabling rapid maintenance and action. The algorithm improves the overall performance of the Toilet Alert System by enabling effective and automatic monitoring of lavatory air quality.

Mobile application: The Toilet Alert System's mobile application offers an intuitive interface for real-time lavatory air quality monitoring. The software, which is compatible with both Android and iOS, pairs with the Arduino-based system wirelessly and obtains real-time data from the gas sensor. Users get access to real-time gas concentrations, customizable odor threshold alarms, and timely notifications in the event that offensive odors are identified. The software also provides historical data records so that users may monitor changes in air quality over time. The mobile application makes lavatory odor level monitoring easy and simple with its user-friendly settings and customizable features.

Proposed System:

Project Planning and Requirements Analysis: Specifying the goals and scope of the Toilet Alert System is one of the main topics in the Project Planning and Requirements Analysis process. It's critical to clearly identify all hardware parts, such as the Bluetooth module, gas sensor, and Arduino board. Gathering requirements focuses on software requirements, like the Arduino IDE and tools for developing mobile apps. The scope of the project describes its characteristics, its constraints, and the planned lavatory environment. Thorough planning guarantees a clear roadmap that directs the circuit design, algorithm development, and component selection stages that follow. A strong foundation is created for the successful installation of an efficient and user-friendly odor monitoring system by paying attention to user needs and deployment considerations.

Component Selection and Acquisition: Making the right hardware component selections is a key choice in the Toilet Alert System Component Selection and Acquisition Analysis. Selected from the MQ series, the gas sensor plays a crucial role in identifying gases that give off an unpleasant odor. The Arduino and mobile app may communicate wirelessly thanks to the selection of Bluetooth modules such as HC-05/HC-06. To achieve best performance, the power supply is carefully considered, with a balance between batteries and adapters. Analyzing the sensitivity, compatibility, and power needs of the sensors is part of the selection process, which guarantees a smooth integration of the sensors into the Arduino-based system. In order to successfully monitor and warn against lavatory odors, the project's purchasing of components is guided by a thorough investigation.

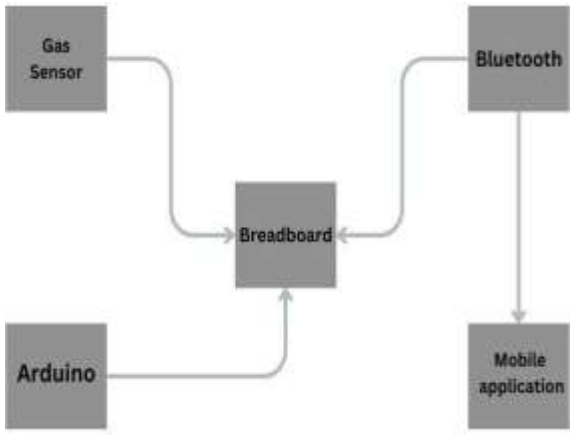
Circuit Design: Organizing fundamental ideas to guarantee flawless operation is the goal of the Toilet Alert System project's Circuit Design Analysis. For reliable data on air quality, the gas sensor is first positioned strategically. Using a predetermined algorithm, the Arduino, which serves as the hub, analyses sensor data and, when needed, sounds an alert. In order to provide real-time monitoring, the Bluetooth module sets up wireless communication with the mobile app. Using lifespan and effective use, power distribution is optimized on the breadboard. While user accessibility and integration with the chosen components contribute to a coherent and efficient circuit design for this cutting-edge odor monitoring system, careful attention to error management and robustness improves overall dependability.

Arduino Programming and Algorithm Development: The goals of Arduino Programming and Algorithm Development for the Toilet Alert System are to receive sensor data, create odor detection algorithms, and enable Bluetooth connection with an effective codebase. Analogue inputs from the gas sensor are interpreted by the Arduino code, which uses a predetermined algorithm to sound an alarm when the gas concentrations meet predetermined criteria. Robust performance is guaranteed by error- handling methods. Sensor reading accuracy is achieved by integrating calibration procedures. Power-efficiency- focused code is optimized, and algorithm improvements are based on real-world testing. A dependable, fast, and user- friendly system for monitoring and warning against offensive lavatory odors is what this procedure attempts togive.

Mobile app development: Developing a user-friendly interface to show real-time sensor data and receive warnings is a crucial component of the Toilet Alert System mobile app development process. With the app, users should be able to easily monitor the quality of the air in restrooms. Adding a feedback feature also makes users more engaged since it lets them comment on how accurate the warnings are or make suggestions for changes. Through continual system improvement based on actual use, this two-way communication fosters a user-centric approach. By guaranteeing responsiveness to user requirements and improving the user experience, a well-thought-out feedback feature adds to the Toilet Alert System's overall efficiency.

Testing, Optimization, and Deployment: To ensure sensor accuracy, communication dependability, and alert response, thorough testing is crucial in the last phases of the Toilet Alert System project. To verify the resilience of the system, testing entails simulating different gas concentrations. Rewriting code, changing thresholds, and improving the user interface in response to test results are the main goals of optimization. The system is deployed in the lavatory environment once it satisfies performance specifications. User accessibility, power supply stability, and ideal placement are all deployment factors. The system's ability to identify and notify users of offensive lavatory odors is ensured by ongoing monitoring after deployment, which enhances user happiness and hygiene.

Flow Chart:



Result and Discussion:

The "Toilet Alert System" was put into place, and it has produced encouraging results in terms of improving and changing restroom experiences. The system effectively gave users timely and relevant information by monitoring restroom odors in real-time, enabling them to make well-informed decisions about using the facilities. The user-friendly mobile application functioned as a clear interface, giving users the ability to more adeptly navigate their surroundings by displaying real-time cleanliness indicators.

The facility managers' proactive alerts were crucial in simplifying the maintenance procedures. Facility hygiene became more effective and responsive as a result of the system's ability to quickly notify responsible parties when odor levels rose above predetermined thresholds and enable prompt corrective action.

The application's built-in user feedback mechanisms encouraged a sense of cooperation between users and facility management. In addition to giving users the ability to actively participate in the ongoing enhancement of restroom conditions, this interaction produced a dynamic feedback loop that allowed the system's algorithms and general effectiveness to be improved.

As discussed, the project's success rests in its ability to establish a new benchmark for restroom management by fusing cutting-edge sensor technology with a user-centric design. The findings demonstrate that even the most basic facets of our everyday lives could undergo a radical transformation when technology is used with an emphasis on user satisfaction and hygiene. The Toilet Alert System is a significant advancement in the fusion of technology and human-centered design towards a more hygienic and cozy world.

Conclusion:

As we come to the end of the "Toilet Alert System" journey, we celebrate the revolutionary changes it has brought about in the realm of restroom management as well as the transformative impact it has on our daily lives. This project successfully bridges the gap between technology and basic human experiences because it was born out of a commitment to user satisfaction and hygienic standards. Our commitment to developing a restroom environment that is smarter, cleaner, and more

user-centric is demonstrated by the combination of cutting-edge sensor technology with an easy-to-use mobile application. Users get unparalleled control over their experiences and are able to make well-informed decisions about using restrooms thanks to the real-time monitoring of restroom odors. Upon considering the achievements of the Toilet Alert System, it becomes clear that this invention goes beyond the typical bounds of smart building technologies. It touches the restroom, an area whose significance is sometimes overlooked. This project redefines user comfort and establishes a new standard for restroom experiences by addressing the subtle aspects of cleanliness and odor management. One of the features of the system is that it can notify faculty members about the restroom's stench and gather user feedback for future maintenance. The ability of technology to improve even the most basic elements of our everyday lives is demonstrated by the Toilet Alert System. It pushes us toward a future where innovation permeates even the smallest spaces, addressing people's happiness and well-being. We hope that this project will have a lasting influence on restroom management techniques as we say goodbye to it, representing a breakthrough in the fusion of technology and human-centered design for a more hygienic and comfortable future.

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