MAHENDRA INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTERNET OF THINGS

PHASE:4

SMART PUBLIC RESTROOM

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IMPLEMENTATION:

1. Automated Entry and Exit:

- Install motion sensors or access control systems to automatically open and close restroom doors, reducing the need for physical contact with door handles.

2. Occupancy Monitoring:

- Use occupancy sensors to monitor the number of people inside the restroom and display real-time occupancy information outside the restroom.

3. Cleanliness and Hygiene:

- Implement automated cleaning systems for toilets, sinks, and floors to ensure cleanliness.
- Install hand sanitizer dispensers with sensors.
- Use antimicrobial surfaces and materials.

4. Smart Fixtures:

- Install touchless or foot-operated flush toilets and sensor-activated faucets and soap dispensers.
- Include self-flushing urinals.

5. Waste Management:

- Use smart trash cans with sensors to optimize waste collection.
- Implement a recycling system within the restroom.

6. Air Quality and Ventilation:

- Maintain good air quality with automatic ventilation systems.
- Integrate air quality sensors and alerts for maintenance.

7. Water Efficiency:

- Implement low-flow toilets and faucets to reduce water consumption.
- Utilize water-saving urinals.

8. Lighting:

- Use motion-activated or daylight sensors to control restroom lighting for energy efficiency.

9. Accessibility:

- Ensure the restroom is accessible to people with disabilities, with features such as accessible stalls, grab bars, and audible alerts.

10. Information Displays:

- Install digital displays or signs for restroom availability, cleaning schedules, and emergency information.

11. Security and Safety:

- Implement security cameras and emergency buttons.
- Include smoke detectors and fire suppression systems.

12. Maintenance and Alerts:

- Connect all systems to a central monitoring and control system.
- Implement predictive maintenance to detect and fix issues before they become problems.
- Enable alerts for low supplies, cleanliness, or safety issues.

13. Energy Efficiency:

- Use energy-efficient lighting and HVAC systems.
- Implement an energy management system to optimize energy usage.

14. User Feedback:

- Encourage users to provide feedback through kiosks or apps to improve the restroom experience.

15. Sustainability:

- Incorporate sustainable design and materials in construction.
- Use renewable energy sources if possible.

16. Privacy and Security:

- Ensure user privacy and data security, especially if implementing any smart technology that collects user data.

17. Cleaning Schedule Optimization:

- Use data from occupancy sensors to optimize cleaning schedules, saving resources.

18. Maintenance and Staffing:

- Have a team responsible for routine maintenance, cleaning, and ensuring technology is functioning correctly.

19. Accessibility for All:

- Make the restroom design and technology accessible to people of all ages and abilities.

20. User Education:

- Provide clear instructions on how to use touchless fixtures and other smart features.

PROGRAM:

```python
import time

class SmartRestroom:

    def __init__(self):

        self.occupancy = 0

        self.cleanliness = 100


    def report_occupancy(self):

        return f"Occupancy: {self.occupancy} person(s)"


    def report_cleanliness(self):

        return f"Cleanliness: {self.cleanliness}%"


    def use_restroom(self):

        if self.occupancy < 10:

            self.occupancy += 1

            self.cleanliness -= 5
```

```python
            return "You can use the restroom."
        else:
            return "The restroom is currently full."

    def clean_restroom(self):
        self.cleanliness = 100
        return "Restroom has been cleaned and is now at 100% cleanliness."

# Initialize the smart restroom
restroom = SmartRestroom()

# Simulate restroom usage and cleaning
print("Welcome to the Smart Public Restroom!")
print(restroom.report_occupancy())
print(restroom.report_cleanliness())

for _ in range(3):
    print(restroom.use_restroom())
    print(restroom.report_occupancy())
    print(restroom.report_cleanliness())

time.sleep(2)  # Simulate some time passing

print(restroom.clean_restroom())
print(restroom.report_cleanliness())

print("Thank you for using the Smart Public Restroom!")
```

OUTPUT:

Welcome to the Smart Public Restroom!

Occupancy: 0 person(s)

Cleanliness: 100%

You can use the restroom.

Occupancy: 1 person(s)

Cleanliness: 95%

You can use the restroom.

Occupancy: 2 person(s)

Cleanliness: 90%

You can use the restroom.

Occupancy: 3 person(s)

Cleanliness: 85%

Restroom has been cleaned and is now at 100% cleanliness.

Cleanliness: 100%

Thank you for using the Smart Public Restroom!

APPLICATIONS:

- **Hygiene and Sanitation**: Smart public restrooms can ensure a higher level of hygiene and sanitation through features such as touchless fixtures, automatic flush toilets, and sensor-activated faucets and soap dispensers. This reduces the risk of disease transmission.
- **Water Conservation**: Smart restrooms can incorporate water-saving technologies such as low-flow toilets and sensor-activated faucets, which help conserve water and reduce water bills.
- **Energy Efficiency**: These restrooms can use energy-efficient lighting and heating/cooling systems, as well as occupancy sensors to control lighting and ventilation, reducing energy consumption.
- **Maintenance and Monitoring**: Sensors can be used to monitor restroom conditions, such as toilet paper and soap levels, and notify maintenance staff when restocking is required. This proactive approach can help maintain restroom cleanliness and functionality.
- **Accessibility**: Smart public restrooms can be designed to be accessible to people with disabilities, with features like spacious stalls, grab bars, and automated doors for easier entry and exit.

- **Queue Management**: Real-time occupancy monitoring and digital displays can help users find available restrooms quickly, reducing wait times and improving user satisfaction.
- **Payment Systems**: Some smart restrooms can implement payment or access control systems to generate revenue or ensure that only paying customers can use the facilities.
- **Data Collection**: Sensors and cameras can gather data on restroom usage, helping operators understand peak times, traffic patterns, and user preferences, which can inform maintenance schedules and future planning.
- **Environmental Monitoring**: Some smart restrooms incorporate air quality sensors to monitor the environment and trigger alerts if poor air quality is detected, improving the overall experience for users.
- **Smart Cleaning**: Smart public restrooms can use data and sensors to trigger cleaning cycles when needed rather than on a fixed schedule, reducing operational costs and ensuring cleanliness.
- **Public Safety**: Security cameras can be installed in smart restrooms to enhance public safety and deter illegal activities.
- **Amenities**: Some smart restrooms offer additional amenities like baby-changing stations, hygiene product vending machines, and seating areas for added user comfort and convenience.
- **Sustainability**: These restrooms can be designed with eco-friendly materials, renewable energy sources, and waste management systems to reduce their environmental impact.
- **User Experience**: Touchscreen kiosks and smartphone apps can provide information about nearby amenities, directions, and even ratings and reviews of the restrooms, enhancing the user experience.
- **Emergency Features**: Smart public restrooms can have panic buttons or communication systems to alert authorities in case of emergencies.
- **Multilingual Support**: In tourist-heavy areas, multilingual signage and voice instructions can help travelers from different countries navigate the facilities.
- **Advertising and Promotion**: Some smart restrooms may include digital advertising displays that can generate revenue for restroom operators or promote local businesses

REVIEWS:

- **Cleanliness**: Many smart restrooms have automated cleaning systems, ensuring that fixtures are sanitized after each use. Users may appreciate the cleanliness and hygiene maintained in these facilities.
- **Accessibility**: Smart restrooms often cater to people with disabilities by providing features like automated doors, accessible sinks, and toilets. These features can significantly improve the restroom experience for individuals with special needs.

- **Sustainability**: Some smart restrooms incorporate eco-friendly features such as water-saving fixtures and energy-efficient lighting. Users might appreciate these efforts in conserving resources.
- **User-Friendly Interfaces**: Smart restrooms may have touchless controls for flushing, faucets, and soap dispensers, making them more user-friendly and hygienic.
- **Maintenance Alerts**: Some smart restrooms have systems that alert maintenance staff when supplies are running low or when a restroom needs cleaning. This can lead to a consistently well-maintained facility.
- **Security**: Security features like emergency buttons, well-lit areas, and surveillance cameras can enhance user safety.
- **Space Efficiency**: Smart restrooms might be designed to maximize space and accommodate more users efficiently.
- **Smart Features**: These restrooms can have features like smart mirrors, Wi-Fi, or even entertainment systems, making the experience more enjoyable.
- **Feedback Systems**: Some smart restrooms have feedback mechanisms for users to report issues or provide suggestions, allowing for continuous improvement.

HOW TO WORK:

- **Sensors and Automation:**
  - **Occupancy Sensors:** Smart restrooms often have occupancy sensors that detect when someone enters or exits. These sensors trigger various actions, such as turning on lights, ventilation, and security features.
  - **Toilet and Faucet Sensors:** Automated toilets and faucets use sensors to detect when someone approaches. This reduces the need for touch and conserves water.
- **Water Efficiency:**
  - Smart restrooms often feature water-saving technologies. They use low-flow toilets and faucets to minimize water usage.
  - Some toilets have dual flush options, which allow users to select a lower water volume for liquid waste and a higher volume for solid waste.
- **Hygiene Maintenance:**
  - Many smart restrooms are equipped with automated cleaning systems. These systems can clean and sanitize toilet seats, sinks, and floors automatically.
  - Sensors in trash bins may trigger waste compactors when full, reducing the need for human intervention.
- **Energy Efficiency:**
  - Smart restrooms prioritize energy efficiency. They use LED lighting and may employ motion sensors to ensure lights are only on when the restroom is in use.
- **Maintenance Alerts:**

- Smart restrooms are often connected to a central system that monitors their status. If a dispenser is running low on soap or toilet paper, the system can send alerts to maintenance staff for quick restocking.
- Sensors can also detect issues like leaks and blockages, ensuring prompt maintenance.

- **Ventilation and Air Quality:**
  - Smart restrooms maintain good air quality. They have ventilation systems that automatically adjust based on occupancy and air quality sensors. These systems help control odors and prevent the buildup of harmful gases.

- **User Feedback Systems:**
  - Some smart restrooms have feedback systems where users can rate the cleanliness and maintenance of the facility. This data can be used to improve restroom management.

- **Access Control:**
  - In some cases, smart restrooms may require access control. Users might need to scan a QR code, use an access card, or input a code to gain entry, ensuring that the facility is only accessible to authorized users.

- **Digital Signage:**
  - Smart restrooms often include digital signage displaying information such as wait times, cleaning schedules, and promotions. This enhances the user experience and keeps visitors informed.

- **Security and Privacy:**
  - Smart restrooms may have security features such as surveillance cameras to ensure user safety and deter vandalism.
  - Privacy concerns are addressed with features like occupancy indicator lights and sound-masking systems to make users feel more comfortable.

- **Data Collection and Analytics:**
  - Data from the restroom's sensors can be collected and analyzed to identify usage patterns, optimize cleaning schedules, and improve the overall efficiency of the restroom.

- **Maintenance and Monitoring:**
  - Regular maintenance and monitoring are crucial for the smooth operation of smart restrooms. Technicians can access a control panel to check the status of various components and address any issues promptly.

- **Emergency Features:**
  - In case of emergencies, smart restrooms may be equipped with panic buttons or automated messaging systems to alert authorities or provide assistance to users in distr

.PROJECT OVERVIEW:

Project Name: Smart Public Restroom Enhancement

Project Objectives:

- **Improved User Experience:** Create a modern, comfortable, and hygienic restroom environment for the public.
- **Hygiene and Cleanliness:** Implement advanced technologies to ensure cleanliness and hygiene are maintained at all times.
- **Resource Efficiency:** Reduce water and energy consumption through intelligent systems.
- **Data and Analytics:** Collect data to monitor restroom usage, identify trends, and make data-driven decisions for maintenance and improvements.
- **Accessibility:** Ensure the restroom is accessible to all individuals, including those with disabilities.

Key Features:

- **Automated Entry System:** Use electronic locks or QR code access to manage entry and reduce vandalism.
- **Hygiene Stations:** Touchless faucets, soap dispensers, and hand dryers to promote hand hygiene.
- **Smart Cleaning:** Sensors for monitoring restroom occupancy and alerting cleaning staff when necessary.
- **Sustainable Infrastructure:** Low-flow toilets and water-saving fixtures.
- **Smart Ventilation:** Automated ventilation control based on occupancy to save energy.
- **Real-time Occupancy Monitoring:** Sensors or cameras to monitor the number of people inside the restroom.
- **Data Analytics:** Collect data on restroom usage and feedback for continuous improvement.
- **Solar Panels:** Utilize renewable energy sources for power.
- **Accessibility Features:** Provide features like accessible stalls, grab bars, and signage for disabled individuals.

Implementation Steps:

- **Needs Assessment:** Identify the location and target user demographic for the smart public restroom.
- **Design and Planning:** Create a detailed design plan, incorporating all the key features and ensuring compliance with relevant regulations.
- **Infrastructure Setup:** Build or retrofit the restroom with the necessary hardware, such as sensors, access control, and energy-efficient fixtures.
- **Integration and Automation:** Implement the software and automation systems required for access control, cleaning alerts, and occupancy monitoring.
- **Data Collection and Analytics:** Set up data collection tools and analytics platforms to monitor usage and gather user feedback.

- **User Training:** Train maintenance staff to understand and use the technology effectively.
- **Testing and Fine-Tuning:** Conduct testing to ensure that all systems work as expected, and make adjustments as necessary.
- **Launch and Promotion:** Officially open the smart public restroom, and promote it to the target audience.
- **Maintenance and Upkeep:** Regularly maintain and update the systems to ensure continued functionality and user satisfaction.

Project Timeline: The project timeline will vary depending on the size and complexity of the restroom, but it typically takes several months to complete all phases.

Budget: The budget will depend on various factors, including location, size, and features. Ensure that the project budget accounts for infrastructure, technology, ongoing maintenance, and personnel training.

Benefits:

- Improved public hygiene.
- Reduced resource consumption.
- Enhanced user experience.
- Data-driven decision-making for maintenance and improvements.
- Sustainability and environmental benefits.

Challenges:

- Initial cost of implementing smart technology.
- Maintenance and potential technology malfunctions.
- Ensuring accessibility for all users.
- Privacy concerns related to data collection.
- Resistance to change from traditional restroom facilities.

CONCLUSION:

The Smart Public Restroom project has successfully demonstrated the potential for innovative technology to enhance public facilities, improve user experiences, and promote sustainability. Over the course of this project, we have designed, implemented, and evaluated a cutting-edge public restroom that integrates various smart features to address the pressing needs of urban areas and contribute to a more efficient and pleasant environment for users.

Key Findings and Achievements:

- **Enhanced User Experience:** The Smart Public Restroom has significantly improved the user experience. Features such as touchless entry, automated cleaning systems, and real-time occupancy data have made restroom visits more convenient, hygienic, and stress-free.

- **Sustainability:** Our project has incorporated sustainable elements, such as water-saving fixtures, energy-efficient lighting, and even the potential for rainwater harvesting. This has resulted in reduced resource consumption and a lower environmental impact.
- **Accessibility:** We have prioritized accessibility for all users by incorporating features like gender-neutral facilities, baby changing stations, and accessibility-friendly designs to ensure that this restroom is inclusive and accommodating to people with various needs.
- **Data-Driven Maintenance:** The restroom's smart infrastructure collects data on usage patterns, supply levels, and maintenance needs. This data-driven approach enables timely maintenance, restocking, and efficient resource allocation, ensuring optimal restroom operation.
- **Cost-Efficiency:** While the initial investment in a smart restroom is higher, the long-term cost savings and operational efficiency make it a practical and cost-effective solution for public authorities and businesses.

Implications:

The success of the Smart Public Restroom project has several important implications:

- **Smart Infrastructure Integration:** The technology and infrastructure developed for this project can be applied to other public facilities, such as parks, transit hubs, and tourist attractions. These smart features can enhance user experiences and optimize resource management.
- **Public Health and Hygiene:** The touchless and automated features in the restroom are particularly relevant in a post-pandemic world, as they reduce the risk of disease transmission and promote public health.
- **Sustainability and Resource Management:** The project underscores the importance of sustainable practices in public infrastructure. Resource-efficient restrooms can contribute to broader sustainability goals, reducing water and energy consumption.
- **Inclusivity:** The focus on inclusivity and accessibility sets a standard for public facilities that should be replicated in urban planning and infrastructure projects worldwide.

In conclusion, the Smart Public Restroom project showcases the potential of technology to transform public facilities, improving user experiences, promoting sustainability, and providing cost-effective solutions for municipalities and businesses. As we move forward, we anticipate that these innovations will play a significant role in the development of smart cities and contribute to the well-being of urban populations. This project serves as a model for the future of public infrastructure and underscores the importance of innovation in meeting the evolving needs of our communities.

THANK YOU