**Project Definition and Design Thinking**

Project Title: Smart Public Restroom using ESP32

Project Overview

The Smart Public Restroom project aims to design and implement an intelligent restroom facility that utilizes the ESP32 microcontroller and various sensors and actuators to enhance user experience, improve hygiene, and optimize maintenance. This document outlines the project's goals, design principles, and key components.

Project Goals

1. Enhanced User Experience: Create a restroom that offers a convenient and hygienic experience to users, including touchless operation of fixtures, real-time occupancy status, and automated features.

2. Efficient Maintenance: Implement sensors and monitoring capabilities to proactively detect issues, schedule maintenance, and reduce downtime.

3. Resource Efficiency: Optimize energy and resource consumption to reduce operational costs and environmental impact.

4. Data Analytics: Gather and analyze restroom usage data for insights into occupancy patterns and maintenance requirements.

Design Thinking Process

Empathize

- Understand the needs and preferences of restroom users.

- Identify pain points and challenges associated with conventional public restrooms.

- Consider the perspectives of administrators responsible for maintenance.

Define

- Clearly define the project scope, objectives, and success criteria.

- Identify key features and functionalities that address user needs and pain points.

Ideate

- Brainstorm innovative solutions and features, considering sensor integration, automation, and user interface design.

- Explore options for connectivity, including Wi-Fi and remote monitoring.

Prototype

- Create a hardware prototype of the restroom system, incorporating ESP32 microcontroller and selected sensors and actuators.

- Develop a software prototype for remote monitoring and control.

Test

- Evaluate the hardware and software prototypes in a controlled environment.

- Collect feedback from potential users and administrators.

- Identify areas for improvement and refinement.

Implement

- Assemble the final hardware system, ensuring compatibility, reliability, and safety.

- Develop production-ready firmware and software.

- Conduct thorough testing to validate the system's performance.

Monitor and Iterate

- Deploy the smart public restroom in a real-world location.

- Continuously monitor the system's performance and collect usage data.

- Use data analytics to refine and optimize system features and maintenance schedules.

Key Components

The following components are integral to the Smart Public Restroom project:

- ESP32 Microcontroller: The central processing unit for the restroom system, responsible for sensor data processing, automation, and communication.

- Sensors: Occupancy sensors, motion sensors, temperature and humidity sensors, toilet seat occupancy sensors, and toilet paper level sensors.

- Actuators: LED lights, exhaust fans, locking mechanisms, dispensers, and flush mechanisms.

- User Interface: A web-based or mobile app interface for users and administrators to monitor and control restroom functions.

- Data Logging and Analytics: Systems for recording and analyzing restroom usage data.

Project Timeline

- Planning and Research

- Prototype Development

- Testing and Refinement

- Deployment

- Monitoring and Optimization: Ongoing

**Conclusion**

The Smart Public Restroom project aims to revolutionize public restroom facilities, providing a modern, efficient, and user-friendly experience. By following the design thinking process and implementing innovative solutions, we hope to create a model for future smart restroom projects that prioritize user comfort, hygiene, and sustainable