Project 7: Smart Public Restroom

Project Title: Smart Public Restroom

Project Steps

Phase 1: Project Definition and Design Thinking

Project Definition: The project aims to enhance public restroom management by installing IoT sensors to monitor occupancy and maintenance needs. The goal is to provide real-time data on restroom availability and cleanliness to the public through a platform or mobile app. This project includes defining objectives, designing the IoT sensor system, developing the restroom information platform, and integrating them using IoT technology and Python.

Design Thinking:

1. Project Objectives: Define objectives such as real-time restroom availability information, cleanliness monitoring, improved user experience, and efficient restroom.
2. IoT Sensor Design: Plan the deployment of IoT sensors (e.g., occupancy sensors, cleanliness sensors) in public restrooms.
3. Real-Time Transit Information Platform: Design a web-based platform and mobile app to display real-time restroom availability and cleanliness data.
4. Integration Approach: Determine how IoT sensors will send data to the restroom information platform.

The objectives of a smart public restroom project can include:

1. Efficiency: To reduce water and energy consumption by implementing smart fixtures and lighting systems that automatically adjust based on occupancy.
2. Hygiene: To enhance cleanliness and sanitation through features like touchless fixtures, automated cleaning schedules, and real-time monitoring of restroom conditions.
3. Accessibility: To ensure the restroom is accessible to all individuals, including those with disabilities, by incorporating features such as accessible stalls, grab bars, and signage.
4. User Experience: To improve the overall experience for restroom users by providing features like real-time occupancy information, air quality monitoring, and pleasant aesthetics.

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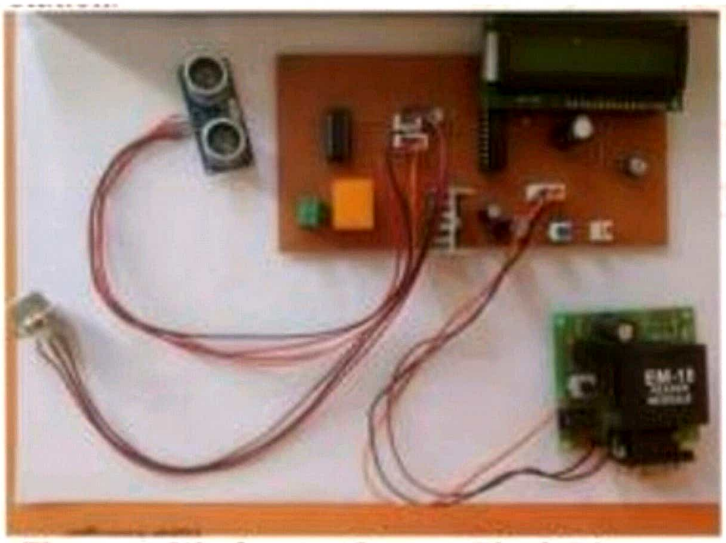
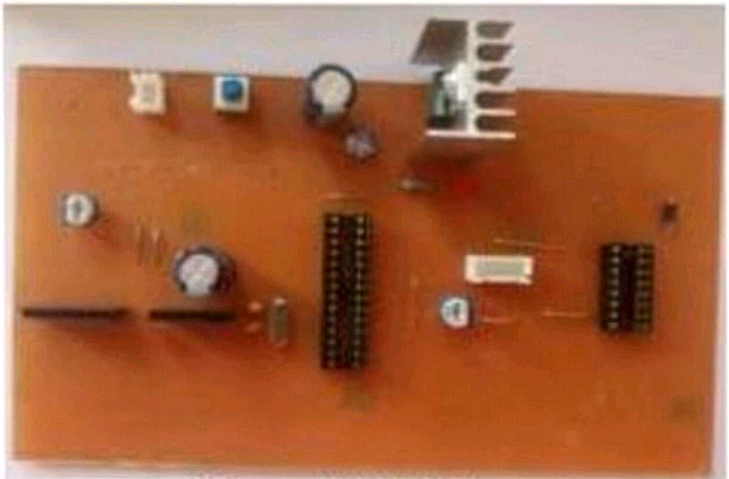
5. Sustainability: To promote eco-friendly practices by using sustainable materials, recycling waste, and reducing water and energy waste.
6. Data Collection and Analysis: To collect data on restroom usage patterns, maintenance needs, and user feedback for continuous improvement.
7. Cost Savings: To reduce operational costs through efficient resource usage and predictive maintenance.
8. Safety: To enhance safety by implementing features like emergency communication systems and well-lit areas.
9. Integration: To ensure seamless integration with other smart building systems and technologies.



Washroom System Block Diagram



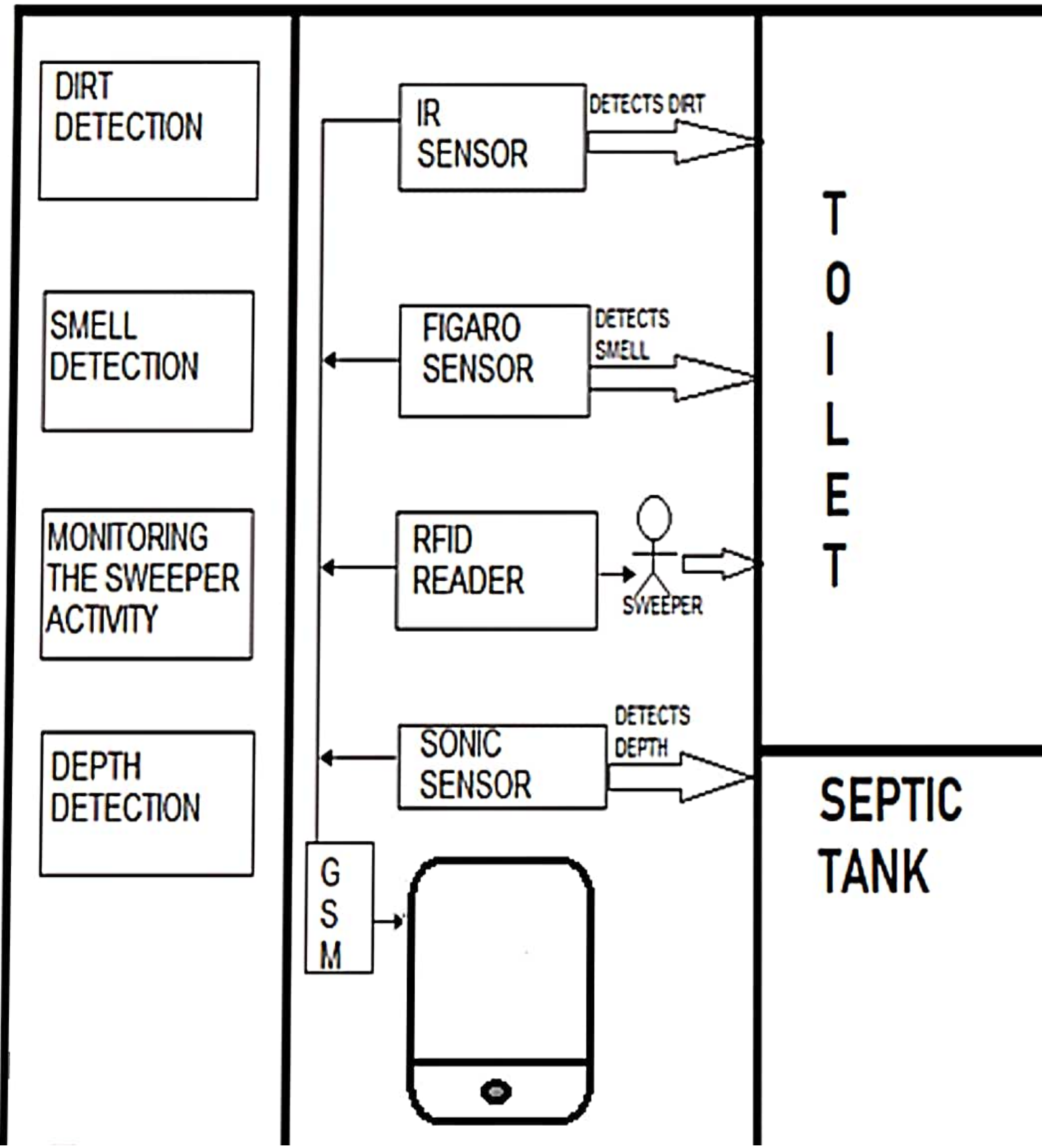
Designing IoT sensors for a smart public restroom project involves several considerations:

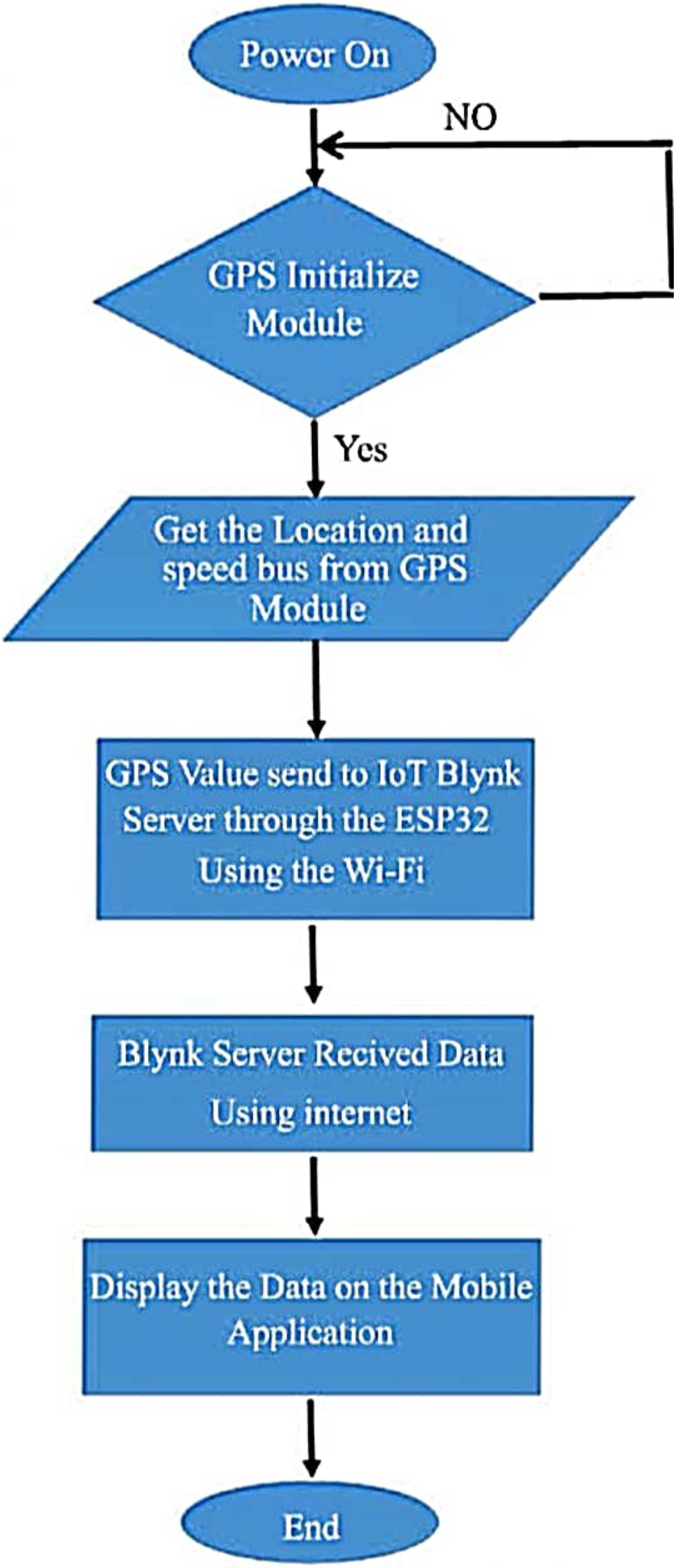
1. Sensor Types:
    - Presence sensors to detect occupancy.
    - Proximity sensors for touchless faucets, soap dispensers, and flush systems.
    - Air quality sensors to monitor ventilation and detect odors.
    - Water quality sensors for leak detection and water usage monitoring.
2. Connectivity:
    - Choose between Wi-Fi, Bluetooth, or other suitable communication protocols.
    - Ensure a reliable connection for data transmission to a central server.
3. Power Source:
    - Consider energy-efficient options like battery power or energy harvesting to prolong sensor life.

4. Data Security:
    - Encrypt sensor data to protect user privacy.
    - Use secure authentication mechanisms for IoT devices.
5. User Feedback:
    - Implement feedback mechanisms like LED indicators or sound alerts for users.
    - Consider smartphone apps for real-time restroom status and alerts.
6. Centralized Control:
    - Develop a central control system to manage and monitor all sensors.
    - Implement automated maintenance alerts.
7. Data Analysis:
    - Utilize data analytics to optimize restroom cleaning schedules and resource allocation.
    - Monitor restroom usage patterns for better resource management.

8. Maintenance:
    - Design sensors with easy access for maintenance and battery replacement.
    - Implement remote diagnostics and troubleshooting capabilities.
9. Accessibility:
    - Ensure that the IoT system caters to individuals with disabilities, with features like voice-activated controls or braille instructions.
10. Sustainability:
    - Design sensors and systems with environmental sustainability in mind, such as low-power components and recyclable materials.

Remember to conduct thorough testing and user feedback sessions to refine the sensor design for optimal functionality and user experience in your smart public restroom project.


DIRT DETECTION
SMELL DETECTION
MONITORING THE SWEEPER ACTIVITY
DEPTH DETECTION
IR SENSOR
DETECTS DIRT
FIGARO SENSOR
DETECTS SMELL
RFID READER
SWEEPER
SONIC SENSOR
DETECTS DEPTH
G S M
TOILET
SEPTIC TANK


Power On
NO
GPS Initialize Module
Yes
Get the Location and speed bus from GPS Module
GPS Value send to IoT Blynk Server through the ESP32 Using the Wi-Fi
Blynk Server Recived Data Using internet
Display the Data on the Mobile Application
End

A real-time transit information platform for a smart public restroom project could provide valuable information to users. Here's how it might work:

1. **Location-Based Information**: The platform can provide information about nearby public transportation options, such as buses, subways, and trains, based on the restroom's location.
2. **Schedules and Timetables**: Users can access real-time schedules and timetables for public transportation services, helping them plan their trips more efficiently.
3. **Service Alerts**: The platform can provide alerts about service disruptions, delays, or changes in public transportation services to keep users informed.

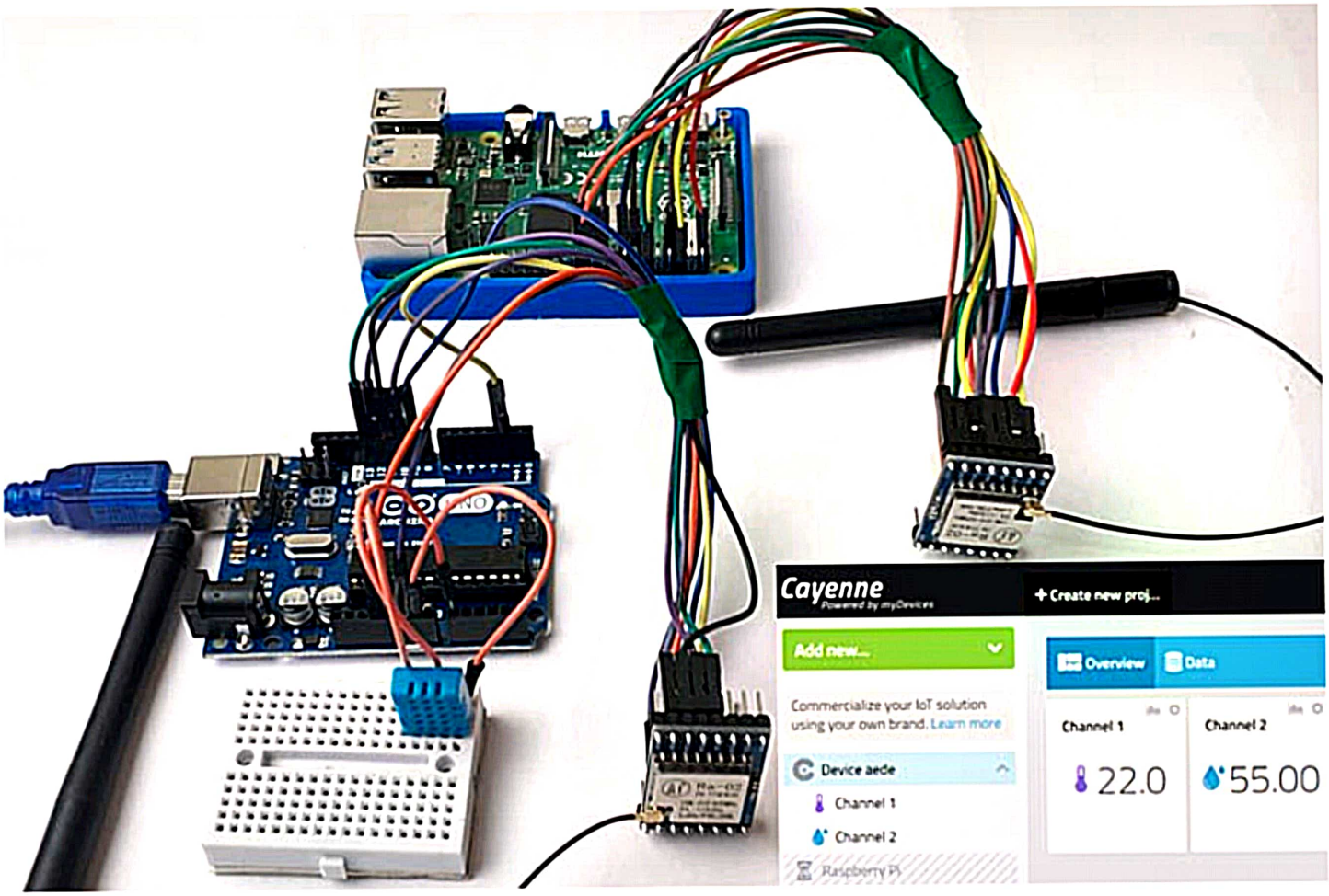
4. **Navigation**: Integration with maps and navigation services can help users find the nearest public transportation stops or stations from the restroom location.
5. **Accessibility Information**: Information on accessibility features for public transportation, such as wheelchair ramps or elevators, can be included to assist individuals with special needs.
6. **Payment Options**: It can also provide details about payment options, such as contactless payments or mobile apps, to streamline the fare payment process.
7. **Crowd Density**: Real-time data on crowd density in public transportation vehicles or stations can help users make informed decisions regarding social distancing.
8. **User Feedback**: A feedback system can allow users to report issues or provide feedback on their public transportation experiences, contributing to continuous improvement.

Creating a smart public restroom project involves various components and integration approaches. Here's a high-level overview:

1. **Sensors and Data Collection:**
    - Deploy sensors for occupancy detection, water usage, and air quality monitoring.
    - Integrate these sensors with a central data collection system.
    - Use IoT protocols like MQTT or HTTP for sensor data transmission.
2. **User Interface:**
    - Develop a user-friendly mobile app or web portal for users to find and access smart restrooms.
    - Integrate real-time occupancy data into the interface to help users locate available facilities.
3. **Access Control:**
    - Implement secure access control mechanisms, such as QR code scans or RFID cards.

4. **Energy Efficiency:**
    - Install motion sensors for lighting and ventilation control to optimize energy usage.
    - Integrate these sensors with the building management system for centralized control.
5. **Water Management:**
    - Use water flow sensors to monitor water usage in sinks and toilets.
    - Connect the sensors to a water management system to detect leaks and control water flow.
6. **Cleaning and Maintenance:**
    - Implement a predictive maintenance system using sensor data to schedule cleaning and maintenance tasks.
    - Connect the maintenance team with a mobile app for efficient task allocation.

1. **Raspberry Pi Data Transmission:**
    - **Sensor Data:** The Raspberry Pi collects data from various sensors within the restroom, such as occupancy sensors, temperature sensors, and air quality sensors.
    - **Data Processing:** The collected data is processed on the Raspberry Pi to extract relevant information, such as restroom occupancy status, temperature, and air quality metrics.
    - **Data Transmission:** The processed data is transmitted to a cloud server or a dedicated database using protocols like MQTT or HTTP. This data includes restroom occupancy status (e.g., vacant or occupied), temperature, and air quality readings.



2. **Mobile App User Interface:**
    - **Login/Authentication:** Users can log in or authenticate using their credentials (if necessary).
    - **Restroom Status:** The main screen displays the status of the restroom, indicating whether it's vacant or occupied. This is typically shown with a simple green or red indicator.
    - **Temperature and Air Quality:** Users can view real-time temperature and air quality readings inside the restroom, ensuring a comfortable and safe environment.
    - **Restroom Location:** If there are multiple restrooms in a facility, the app can display a list of restroom locations and their respective statuses.
    - **History and Analytics:** Users can access historical data and analytics to see trends in restroom occupancy, temperature, and air quality over time.