
DEVELOPMENT OF SMART PUBLIC RESTROOM USING IOT

INTRODUCTION

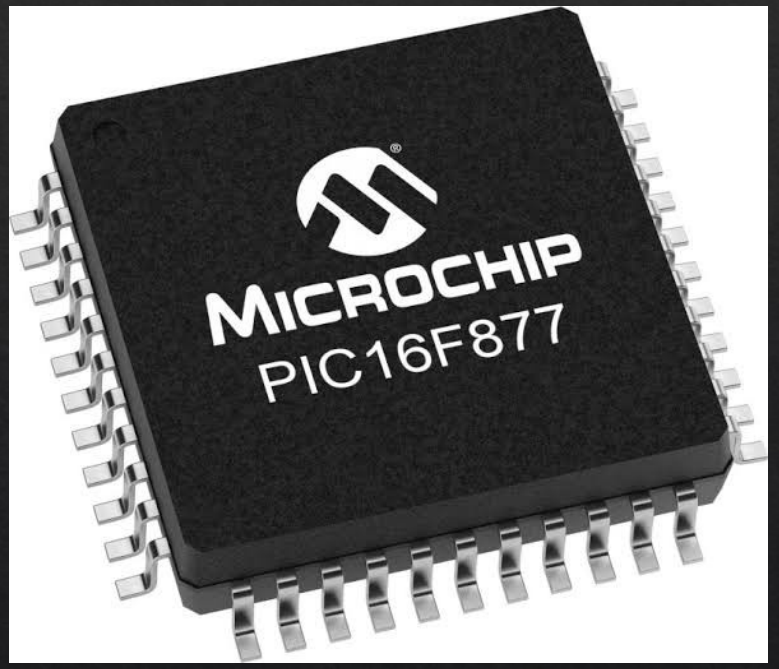
- Developing a smart public restroom using IOT involves integrating various technologies to enhance user experiences, improve maintenance, and promote sustainability.

- Developing a smart public restroom using IOT involves careful planning, integration, and ongoing maintenance to provide a convenient and hygienic experiences and users while optimizing resources and improving overall efficiency.

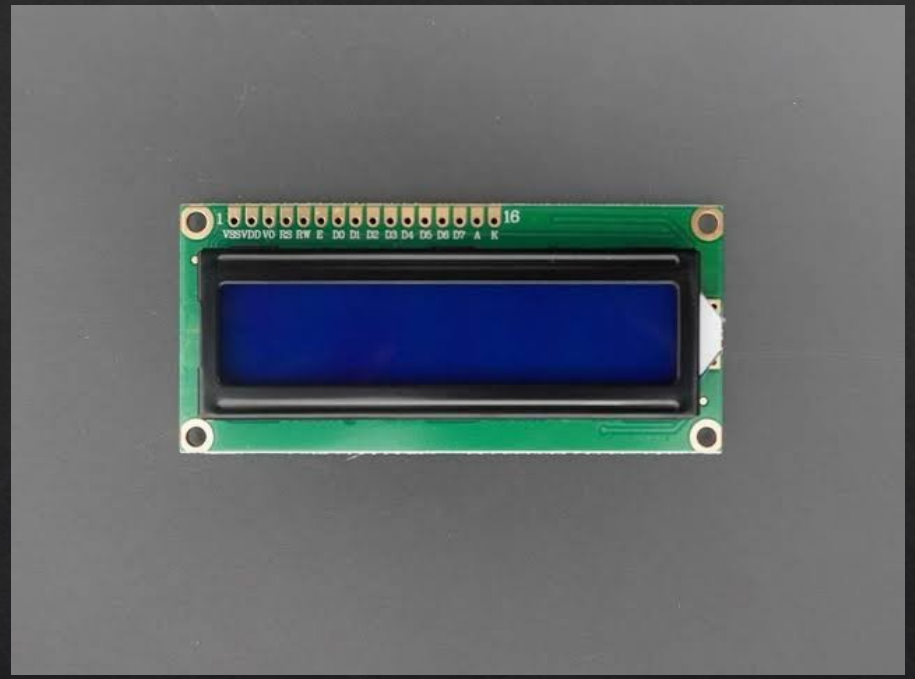
- Introduce to use and maintain the toilets in the clean and hygienic way. The project is based on IOT concepts using different sensors like smell sensor, dirt sensor, sonic sensor, RFID reader, Database. Using these materials we are trying to provide the clean toilets

HARDWARE REQUIREMENTS TO BUILT IOT SENORS

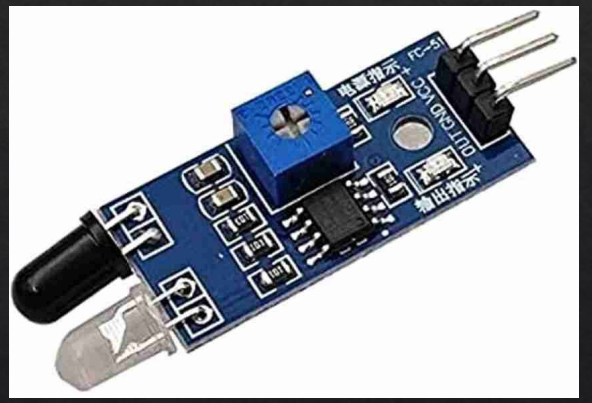
- **MICROCONTROLLER** : A microcontroller is a small computer on a single combined circuit holding a processor core, memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general-purpose applications. PIC 16F877 is one of the most advanced microcontroller from Microchip. This controller is commonly used for experimental and modern applications because of its low price, wide range of requests, high quality, and ease of obtainability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The PIC 16F877 features all the mechanisms which present microcontrollers usually have.



- **LCD** : LCD stands for Liquid Crystal Display. By using the LCD, all the outputs are displayed. LCD doesn’t know about the content (data or commands) supplied to its data bus. It is the user who has to specify whether the content at its data pins are data or commands. Display For this, if a command is inputted then a certain arrangement of 0s and 1s has to be applied to the Control lines so as to specify it is a command on the other hand if a data is inputted at the data lines then an another combination of 0s and 1s has to be applied to the control lines to require it is Data.



- **BUZZER**: Buzzer is also called as Beeper. It is a sound signaling mechanical device.
- **INFRARED SENSOR :** The IR sensor is used to detect the dirt present in the toilet. Here we nourish the image models into the sensor. It can perceive the dirt by comparing the images we feed into it, after using the toilet. If it can detect the dirt, it raises the alarm, and the users may get embraced and they clean it. This system can create the responsiveness among the people.

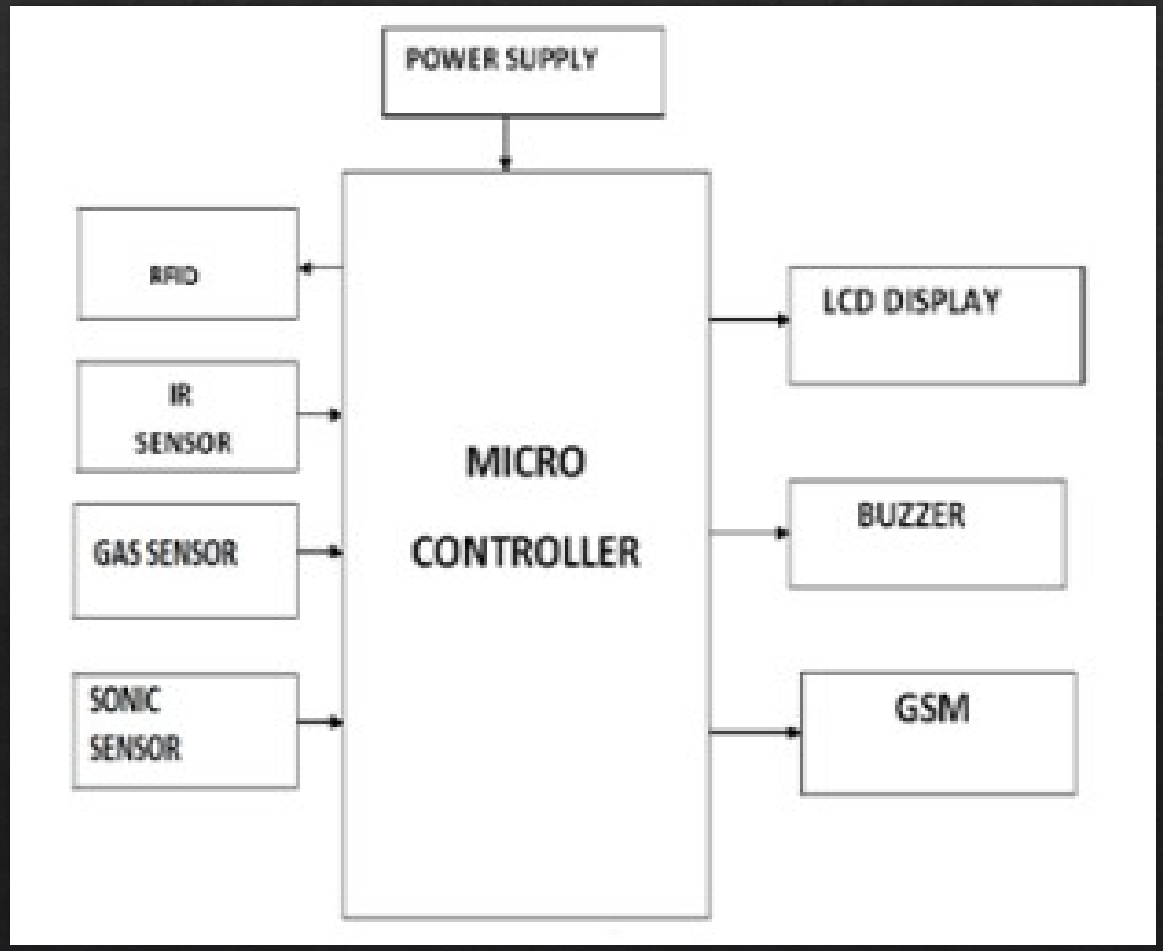


- **SMELL SENSOR :** The Smell Sensor is used to detect the unwanted smell and gases in the toilet. For this purpose, we are going to use the sensor called Figaro sensor. It cans intellect the dry gases present in the toilets such as NH3, CO2, CH4, H2S, etc. By taking those gases leads to Nausea, Drowsiness, instant loss of awareness, etc. After sensing the unwanted gases, it can blink the red light. Then the sweeper can clean it by using particular Cleaning Agents.

- **RFID READER:** The RFID stands for Radio Frequency Identification. It can be used for monitoring the Sweeper. The Organization wishes to provide the identity tag for the Sweeper. The Sweeper desires to show the tag before the cleaning process is going to start and after it is finished. Then the CR4 sensor can spot the presence of dirt. If it is present, it can blink the red light. If it is clean, it can blink the blue light. It assistances to understand the responsibilities of sweeper by his/her own. If Sweeper is not clean the toilets for period of time, his/her absence in cleaning the toilet also reported to the dependable organization. These all the details are stored in the database.

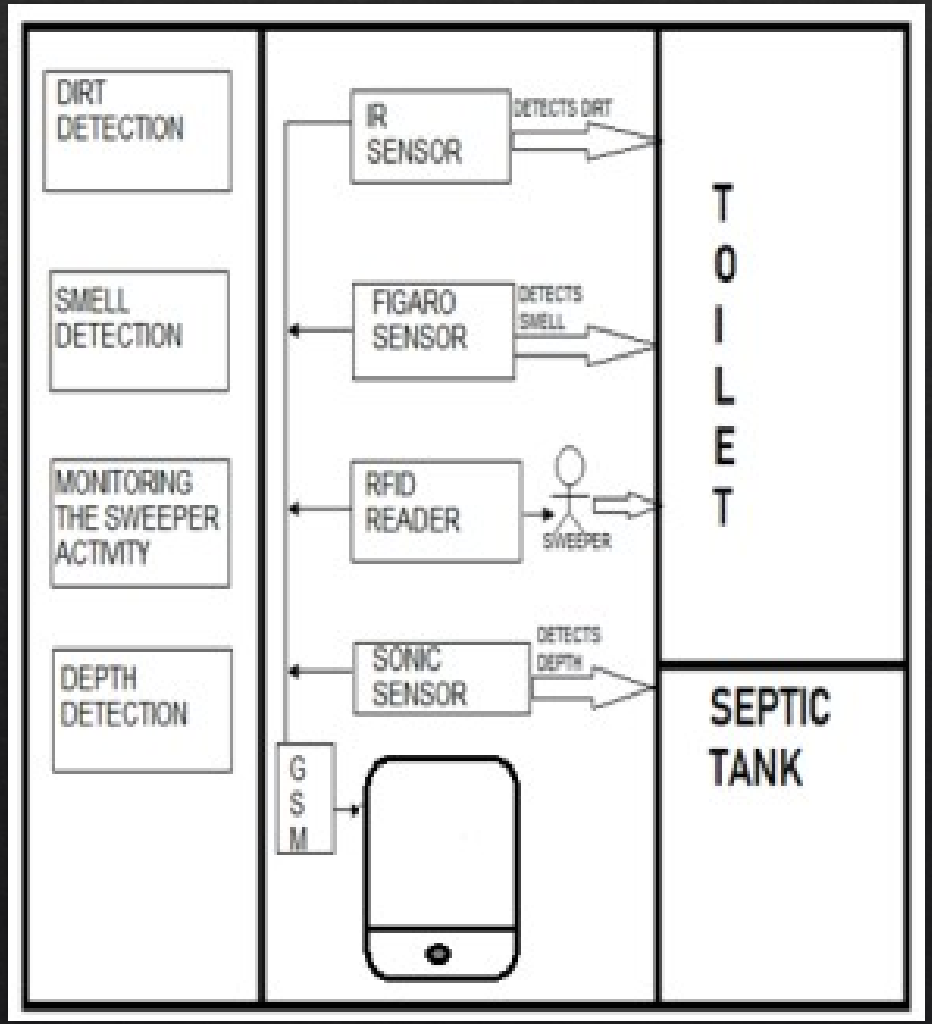
- **SONIC SENSOR:** The Sonic Sensor is used for computing the depth. Here it is used to measure the depth of the septic tank. The Sonic Sensor is fixed into the Septic tank. Then the Septic tank get filled means, it can sends the communications to particular organization. Then they will allot persons to clean the septic tank. This ultrasonic sensor can be used for measuring distance, object sensor, motion sensors etc. High sensitive module can be used with microcontroller to integrate with motion circuits to measure the distance, position & motion sensitive products. In a nutshell, water depth sensing is using a sensor to measure the depth of water in a tank or container. Although various sensors can be used for this application, we will talk about ultrasonic sensor application. With ultrasonic sensors, we can find the water depth calculation by finding the distance between the transceiver and the surface of the water. The sensor will transmit a short ultrasonic pulse, and we can measure the travel time of that pulse to the liquid and back. We can then subtract that distance from the total depth of the tank to determine the water depth.

Block diagram of the proposed system



- **GSM:** GSM stands for Global System for Mobile communication. It establishes the mobile communication from It transfers the information from main circuit to operator. It uses Time Division Multiple Access (TDMA). GSM is mainly used for communicating and transferring message from one person to concerned organization. GSM module is used to establish communication between a computer and a GSM and GPRS system. om one place to another place. Here we are using GSM LT-2 communication module makes it possible to use GSM paths to provide monitoring and messaging functions in alarm systems. It facilitates cooperation with SATEL and third party control panel diallers or correctly configured outputs. Here GSM LT-2 module makes it possible to implement monitoring as well as text and voice messaging functions. The caller ID retransmission function creates it likely to present the incoming callers number on telecommunication station sarmed with this functionality. GSM alarm system built-in GSM communication module inside, work as a mobile handset. After purchased the GSM alarm system, people need to acquisition the SIM card, and select the mobile service package. GSM alarm system can program several phone numbers for alarm receiving. When any abnormal event happens, the system will response, then inform the owner via voice call and short message (SMS). GSM will check the messaging activities for sweepers and also need to check with their cleanliness duty for their work. The sweepers need to check with particular activity of its work by their sensors.

ARCHITECTURE OF THE PROPOSED SYSTEM



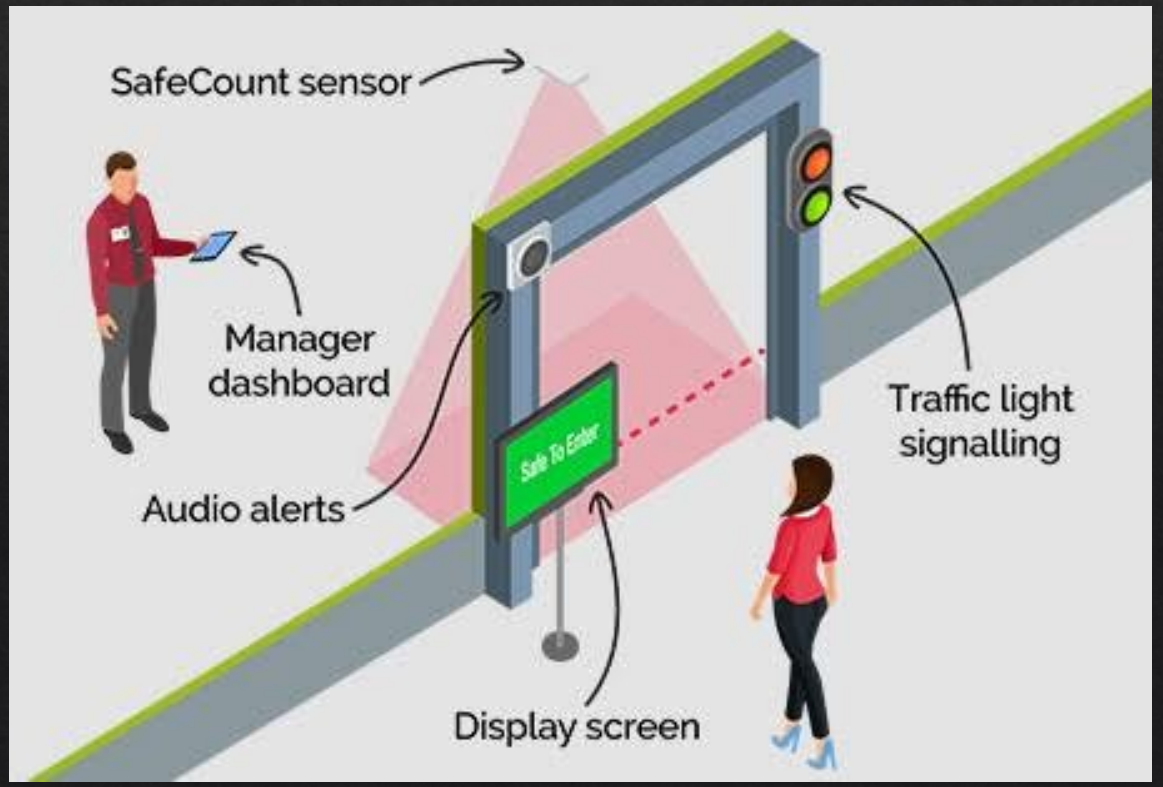
DEPLOY IOT SENORS IN PUBLIC RESTROOM TO COLLECT DATA

- **WHAT IS AN OCCUPANCY MONITORING SYSTEM?**

The occupancy monitoring system is a system that uses occupancy monitoring sensors deployed at different parts of an area being monitored to detect people count, people movement, duration, and other statistical information. The sensors send real-time data to a central management dashboard. The dashboard is cloud-based and can be accessed at any time, from any connected device. It can also be configured to send instant alerts to the building manager if a specific activity takes place or if a planned activity does not take place.

- **The need for washroom occupancy monitoring:**

A well-functioning washroom occupancy monitoring system is needed to ensure the maintenance of proper hygiene in the washroom through regular cleaning.



BENEFITS OF IOT-ENABLED WASHROOM OCCUPANCY MONITORING

WASHROOM CLEANING ON DEMAND

It is possible to use anonymous footfall data to establish a consistent level of hygiene and cleanliness. When washroom cleaning is demand-based, it becomes easier to optimize the use of existing resources to ensure that the janitorial team cleans when needed. As an example, an alert system can be created to inform washroom cleaning staff to initiate washroom cleaning after ten people have used the facility.

WORKING OF IOT ENABLED WASHROOM OCCUPANCY MONITORING SYSTEM

- An IoT-based washroom occupancy monitoring system uses a variety of sensors, scanners, and other sophisticated devices to implement occupancy monitoring. Here's a list of the key components of an IoT-based washroom occupancy system

DOOR SENSORS

- In washroom occupancy monitoring applications, a door sensor counts the number of times the door is opened/ closed. In conjunction with the data from the rest of our sensors in the restroom, the algorithm calculates overall traffic
- flow.

- The sensor is a magnetic contact switch, with one half mounted on the door, and the other half mounted on the door frame. The sensor connects to a device that communicates with a gateway.

ROOM OCCUPANCY SENSORS

- Different Washroom occupancy sensors use different methods to count the number of people walking in/out of a washroom. One of these methods is Time of Flight (TOF) technology. This technology detects the number of people walking in/ out through the door very accurately. The IR sensing direction device will count the people walking in and walking out.

- The sensor is typically installed in the
- ceiling and it can detect objects up to a 3meter distance. The sensor continuously monitors the traffic and communicates with a gateway using LoRaWAN or other LPWAN technology.

Programming the sensor

write a python script that interfaces with the sensor and collect data. We will need to include libraries or modulus specific to our sensor type.

Implement code to read data from the occupancy and cleanliness sensors.

Ensure that the script collects and process data at regular intervals.

Python program

- **Algorithm**
  - Import the libraries or modulus for the occupancy and cleanliness sensors.
  - Initialize and configure the sensors using the appropriate setup functions.
  - Create functions to read data from each sensor.
  - Implement a function to send data to your restroom information platform.
  - In the main() function, read data from both sensors at specified intervals and send it to the platform.
  - Add error handling to manage exceptions that may occur during sensor reading or data transmission.

Program

```
import time
import occupancy_sensor_module                    # Replace with your occupancy sensor library
import cleanliness_sensor_module                  # Replace with your cleanliness sensor library
# Initialize and configure the occupancy sensor
occupancy_sensor = occupancy_sensor_module.setup()          # Replace with sensor setup code
# Initialize and configure the cleanliness sensor
cleanliness_sensor = cleanliness_sensor_module.setup()          # Replace with sensor setup code
def read_occupancy():
        occupancy_data = occupancy_sensor_module.read_data()  # Replace with sensor-specific read function
        return occupancy_data
```

```
def read_cleanliness():
cleanliness_data = cleanliness_sensor_module.read_data()      # Replace with sensor-specific read function
return cleanliness_data
def send_data_to_platform(occupancy_data, cleanliness_data):
# Implement code to send data to your restroom information platform
# This may involve formatting data as required by the platform and using HTTP, MQTT, or other protocols
def main():
while True:
try:
        occupancy_data = read_occupancy()
        cleanliness_data = read_cleanliness().
```

```
                send_data_to_platform(occupancy_data, cleanliness_data)
# Wait for a specified interval before reading data again
                time.sleep(10)  # Adjust as needed
        except Exception as e:
                print("Error:", str(e))
                # Implement error handling, such as logging or retries
if __name__ == "__main__":
        main()
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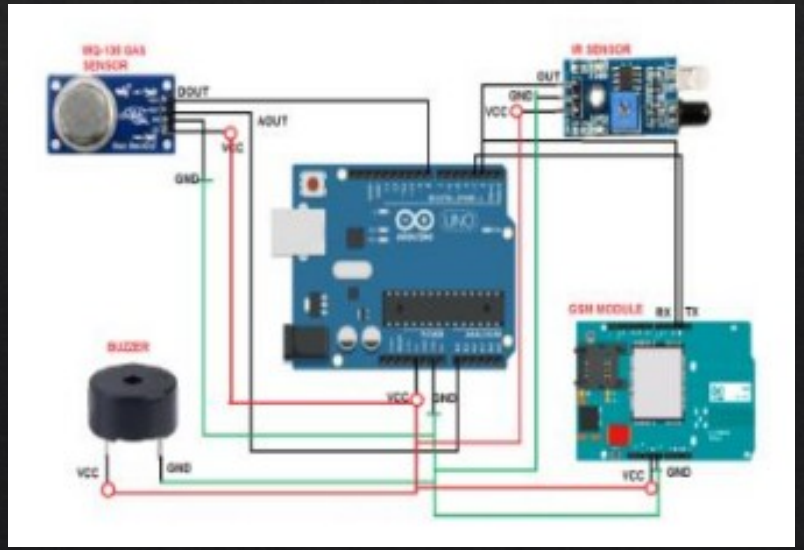
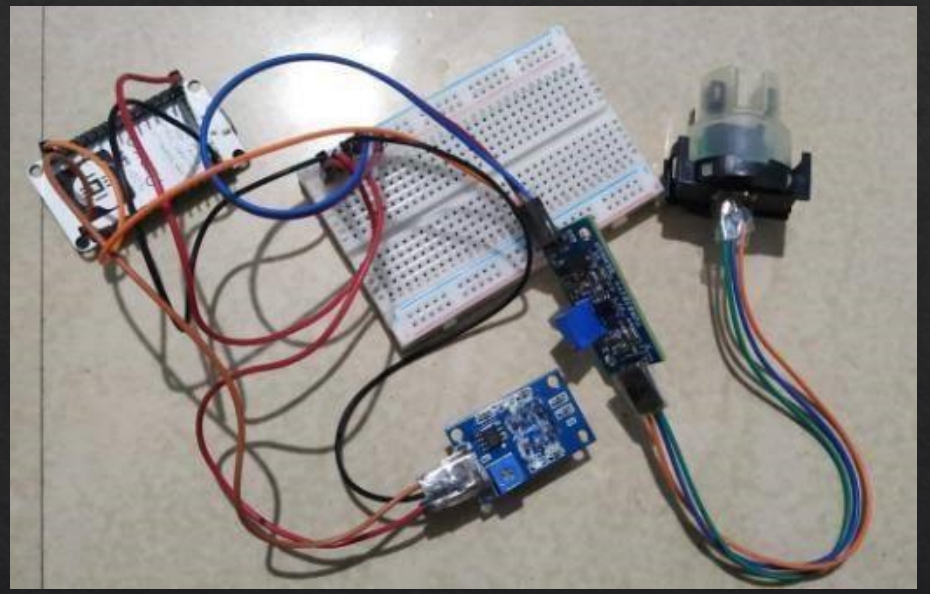


- Data formatting: Format the data in a way that is suitable for transmission. This might include converting data to JSON or another structured format.
- IoT connectivity: Depending on the server, configure it to connect to the internet using Wi-Fi, cellular, or other connectivity options. We need to include authentication and security measures for data transmission.
- Data transmission: Use libraries or modules to send the data to the restroom information platform. Common protocols for IoT communication include MQTT,HTTP, or CoAP. Ensure the platforms API or endpoint is correctly set up to receive the data.
- Error handling: Implement error handling and retry mechanisms to account for intermittent connectivity issues.
- Logging and debugging: Add logging and debugging capabilities to the python script to help troublehsoot issues remotely.

- Testing: Thoroughly test the script and sensor in a controlled environment to ensure that data is being sent reliably and accurately.
- Deployment: Install the python script on the IoT sensor device. This may involve transferring the script and configuring the sensor to run it on boot.
- Security: Ensure that the IoT sensor and the python script have appriate security measures in place to protect against unauthorized access and data breaches.
- Monitoring and maintenance: Regularly monitor the IoT sensor and the data it transmits to the platform to ensure its continued operation. Schedule maintenance tasks such as software updates, sensor calibration, and battery replacement if applicable.
    - Scaling: If you plan to deploy multiple IoT sensor, consider how they will be managed and scaled in the future.
    - Documentation: Document the deployment process, including configurations, sensor specifications, and any relevant information for future reference.

- The specific implementation details may vary based on the IoT sensor we are using the connectivity options available, and the requirements of our restroom information platform. Additionally, the code and script should be customized to match the hardware and software environment of our IoT sensor.



This is the phase 3 project for smart public restroom.

THANK YOU