

PHASE-4

SMART PUBLIC RESTROOM

Sensors and Hardware Setup:

Install occupancy sensors to monitor restroom usage. Use water flow and motion sensors to detect handwashing and flush activities. Implement a smart lock and occupancy indicator for each restroom stall.

Data Collection:

Gather data from sensors continuously. Store data in a database or cloud service.

Data Preprocessing:

Perform initial data cleaning and filtering. Handle missing data and outliers

Feature Engineering:

Create relevant features from the collected data.

For example:

Calculate the average time a person spends in the restroom. Count the number of flushes or handwashing events. Determine peak usage hours. Analyze restroom occupancy patterns

Machine Learning for Predictive Maintenance:

Develop machine learning models to predict when maintenance is required based on sensor data (e.g., predicting when a toilet might get clogged). Use regression or classification models for predictive analysis.

User Interface (UI):

Create a user-friendly interface to display restroom occupancy, usage statistics, and maintenance alerts. Implement a mobile app or a web dashboard.

Alerts and Notifications:

Set up automated alerts for restroom maintenance staff when issues are detected. Integrate email or SMS notifications.

Energy Efficiency:

Use IoT to optimize energy usage, such as lighting and HVAC systems. Implement occupancy-based control for these systems.

Data Analysis and Visualization:

Utilize data analysis tools (e.g., Python with libraries like Pandas, NumPy) to gain insights from the data. Visualize the data using tools like Matplotlib or data visualization libraries.

Security and Privacy:

Ensure data security and privacy by encrypting data and following relevant regulations

Testing and Maintenance:

Thoroughly test the system for accuracy and reliability. Regularly maintain the hardware and update software as needed.

Code :

```
import pandas as pd
import numpy as np
import datetime

# Sample sensor data (replace with actual sensor data)
data = {
    'timestamp': [datetime.datetime(2023, 10, 27, 8, 0, 0),
                  datetime.datetime(2023, 10, 27, 8, 15, 0),
                  datetime.datetime(2023, 10, 27, 8, 30, 0),
                  datetime.datetime(2023, 10, 27, 8, 45, 0)],
    'occupancy': [1, 0, 1, 1],
    'flushes': [2, 1, 0, 3],
    'handwash': [3, 2, 1, 4]
}

df = pd.DataFrame(data)
```

```
# Feature engineering
df['occupancy_duration'] =
df['timestamp'].diff().dt.total_seconds().fillna(0)
df['avg_occupancy_duration'] =
df['occupancy_duration'].rolling(window=3).mean()
df['total_flushes'] = df['flushes'].cumsum()
df['total_handwash'] = df['handwash'].cumsum()

# Calculate occupancy rate
total_time = (df['timestamp'].iloc[-1] -
df['timestamp'].iloc[0]).total_seconds()
total_occupancy = df['occupancy'].sum()
occupancy_rate = (total_occupancy / total_time) * 100

print("Feature-Engineered Data:")
print(df)
print(f"Occupancy Rate: {occupancy_rate:.2f}%")
```