DEVELOPMENT OF WATER MANAGEMENT USING PYTHON SCRIPT

(WATER QUALITY PREDICTION)

INTRODUCTION

Smart water management typically involves using sensors and data analysis to monitor and control water usage in a more efficient and sustainable way. Below is a simple example of Python code for a smart water management system using a hypothetical scenario. This code demonstrates how you can collect data from sensors and make decisions based on that data.

ABOUT DATASET

1.pH value:

PH is an important parameter in evaluating the acid–base balance of water. It is also the indicator of acidic or alkaline condition of water status. WHO has recommended maximum permissible limit of pH from 6.5 to 8.5. The current investigation ranges were 6.52–6.83 which are in the range of WHO standards.

2.Hardness:

Hardness is mainly caused by calcium and magnesium salts. These salts are dissolved from geologic deposits through which water travels. The length of time water is in contact with hardness producing material helps determine how much hardness there is in raw water. Hardness was originally defined as the capacity of water to precipitate soap caused by Calcium and Magnesium.

3.Solids (Total dissolved solids - TDS):

Water has the ability to dissolve a wide range of inorganic and some organic minerals or salts such as potassium, calcium, sodium, bicarbonates, chlorides, magnesium, sulfates etc. These minerals produced un-wanted taste and diluted color in appearance of water. This is the important parameter for the use of water. The water with high TDS value indicates that water is highly mineralized. Desirable limit for TDS is 500 mg/l and maximum limit is 1000 mg/l which prescribed for drinking purpose.

4.Chloramines:

Chlorine and chloramine are the major disinfectants used in public water systems. Chloramines are most commonly formed when ammonia is added to chlorine to treat drinking water. Chlorine levels up to 4 milligrams per liter (mg/L or 4 parts per million (ppm)) are considered safe in drinking water.

5.Sulfate:

Sulfates are naturally occurring substances that are found in minerals, soil, and rocks. They are present in ambient air, groundwater, plants, and food. The principal commercial use of sulfate is in the chemical industry. Sulfate concentration in seawater is about 2,700 milligrams per liter (mg/L). It ranges from 3 to 30 mg/L in most freshwater supplies, although much higher concentrations (1000 mg/L) are found in some geographic locations.

6.Conductivity:

Pure water is not a good conductor of electric current rather's a good insulator. Increase in ions concentration enhances the electrical conductivity of water. Generally, the amount of dissolved solids in water determines the electrical conductivity. Electrical conductivity (EC) actually measures the ionic process of a solution that enables it to transmit current. According to WHO standards, EC value should not exceeded 400 μS/cm.

7.Organic_carbon:

Total Organic Carbon (TOC) in source waters comes from decaying natural organic matter (NOM) as well as synthetic sources. TOC is a measure of the total amount of carbon in organic compounds in pure water. According to US EPA < 2 mg/L as TOC in treated / drinking water, and < 4 mg/Lit in source water which is use for treatment.

8.Trihalomethanes:

THMs are chemicals which may be found in water treated with chlorine. The concentration of THMs in drinking water varies according to the level of organic material in the water, the amount of chlorine required to treat the water, and the temperature of the water that is being treated. THM levels up to 80 ppm is considered safe in drinking water.

9.Turbidity:

The turbidity of water depends on the quantity of solid matter present in the suspended state. It is a measure of light emitting properties of water and the test is used to indicate the quality of waste discharge with respect to colloidal matter. The mean turbidity value obtained for Wondo Genet Campus (0.98 NTU) is lower than the WHO recommended value of 5.00 NTU.

10.Potability:

Indicates if water is safe for human consumption where 1 means Potable and 0 means Not potable.

Predicting water quality involves using historical data and machine learning techniques to forecast the quality of water in a given area, which is crucial for environmental protection and public health. Below is an example Python script that demonstrates how to build a basic water quality prediction model using Python. Please note that this is a simplified example, and real-world water quality prediction models may require more extensive data and feature engineering.

PYTHON SCRIPT:

```
# Import necessary libraries
import pandas as pd
from sklearn.model_selection import
train_test_split
from sklearn.ensemble import
RandomForestRegressor
from sklearn.metrics import
mean_squared_error
import matplotlib.pyplot as plt

# Create a synthetic water quality dataset
data = pd.DataFrame({
    'temperature': [10, 15, 20, 25, 30, 35, 40, 45,
50, 55],
    'pH_level': [6.5, 6.2, 6.0, 5.8, 5.7, 5.5, 5.4, 5.3,
5.2, 5.0],
```

'dissolved_oxygen': [8.2, 7.8, 7.5, 7.1, 6.8, 6.6, 6.3, 6.0, 5.8, 5.5],

'water_quality': [80, 75, 70, 65, 62, 60, 58, 55, 53, 50]

})

Data preprocessing

X = data.drop(columns=['water_quality'])

y = data['water_quality']

Split the dataset into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

Train a machine learning model (Random Forest Regressor)

```
model =
RandomForestRegressor(n_estimators=100,
random_state=42)
model.fit(X_train, y_train)

# Make predictions on the test set
y_pred = model.predict(X_test)

# Evaluate the model
mse = mean_squared_error(y_test, y_pred)
print(f"Mean Squared Error: {mse}")

# Visualize the actual vs. predicted values
plt.scatter(y_test, y_pred)
plt.xlabel("Actual Water Quality")
plt.ylabel("Predicted Water Quality")
plt.title("Actual vs. Predicted Water Quality")
```

```
plt.show()
```

OUTPUT:

Mean Squared Error: 4.3275

EXPLANATION:

- We create a synthetic water quality dataset with three features: temperature, pH level, and dissolved oxygen, as well as a target variable, water_quality.

- We split the dataset into training and testing sets (80% training, 20% testing) to train and evaluate the model.

- We use a Random Forest Regressor model to predict water quality based on the provided features.

- The output shows the Mean Squared Error (MSE), which is a measure of the model's prediction accuracy. In this case, the MSE is 4.3275, indicating the average squared difference between the actual and predicted water quality values.

- Additionally, a scatter plot is generated to visualize the relationship between the actual and predicted water quality values. However, as this is a synthetic dataset, the plot may not be very informative. In practice, you would use real-world data for more meaningful insights.

- This is a simplified example to illustrate the process of water quality prediction using a machine learning model. In a real-world application, you would work with more extensive and meaningful datasets to make more accurate predictions.

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CONCLUSION:

Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system proposed in this paper is an efficient, inexpensive IoT solution for real-time water quality monitoring.