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MATLAB Analysis and Visualization

Dataset link:

https://github.com/TakMashhido/Gas-Sensors-Measurements-Dataset/tree/main

Thingspeak Analysis channel link:

https://thingspeak.mathworks.com/channels/3209217

Matlab analysis and preparation:

Smoothing and classification

MATLAB Code

```
readChannelID = 3209217;
readKey = '4ZLNSW8A41U0UAJ6';
fields = [1 2 3 4 5];   % MQ-2, MQ-3, MQ-6, MQ-135, Temperature
numPoints = 1000;

[raw_data, time] = thingSpeakRead(readChannelID, ...
    'Fields', fields, ...
    'NumPoints', numPoints, ...
    'ReadKey', readKey);
cleanData = fillmissing(raw_data, 'linear');
data = movmean(cleanData, 5);
mq2   = data(:,1);
mq3   = data(:,2);
mq6   = data(:,3);
mq135 = data(:,4);
temp  = data(:,5);

sensorNames = {'MQ-2','MQ-3','MQ-6','MQ-135','Temp'};

thresholds = [600, 500, 380, 420, 27.5];

% Classification: 1 = Alert, 0 = Normal
status = [
    mq2   > thresholds(1), ...
    mq3   > thresholds(2), ...
    mq6   > thresholds(3), ...
    mq135 > thresholds(4), ...
    temp  > thresholds(5)
];

%Counts
alertCounts  = sum(status);
normalCounts = numPoints - alertCounts;

analysisTable = table( ...
    sensorNames', ...
    thresholds', ...
    normalCounts', ...
    alertCounts', ...
    'VariableNames', {'Sensor','Threshold','Normal_Count','Alert_Count'} ...
);

disp('--- Classification Analysis Results ---');
disp(analysisTable);
```

Name

Fill NA , Smoothing, Statistical Analysis (Correlation)

MATLAB Code

```
readChannelID = 3209217;
readKey = '4ZLNSW8A41U0UAJ6';
numPoints = 500;

[data, time] = thingSpeakRead(readChannelID, ...
    'Fields', [1 2 3 4 5], ...
    'NumPoints', numPoints, ...
    'ReadKey', readKey);
%--Prepare(cleaning and smoothing)----
cleanData = fillmissing(data, 'linear');
smoothedData = movmean(cleanData, 5);

%---Analyze(statistical analysis correlation)----
mqData = smoothedData(:, 1:4);
sensorNames = {'MQ-2','MQ-3','MQ-6','MQ-135'};

R = corr(mqData, 'Rows', 'pairwise');

correlationTable = array2table(R, ...
    'VariableNames', sensorNames, ...
    'RowNames', sensorNames);

disp('--- Correlation Analysis Results ---');
disp(correlationTable);


```

Remove NA, Normalize and Calculate Composite gas contamination index

MATLAB Code

```
readChannelID = 3209217;
fields = [1 2 3 4 5];          % MQ-2, MQ-3, MQ-6, MQ-135, Temperature
numPoints = 500;

[data, time] = thingSpeakRead(readChannelID, ...
    "Fields", fields, ...
    "NumPoints", numPoints);

% --- Prepare Technique (Remove missing values and Normalization) ---
validIdx = ~any(isnan(data), 2);
data = data(validIdx, :);
time = time(validIdx);

mq2   = data(:,1);
mq3   = data(:,2);
mq6   = data(:,3);
mq135 = data(:,4);
temp  = data(:,5);

%Normalization
norm01 = @(x) (x - min(x)) ./ max(max(x) - min(x), eps);

mq2_n   = norm01(mq2);
mq3_n   = norm01(mq3);
mq6_n   = norm01(mq6);
mq135_n = norm01(mq135);

% --- Analyze technique (Composite Gas Contamination Index) ---
gasIndex = 100 * mean([mq2_n mq3_n mq6_n mq135_n], 2);

avgTemp = mean(temp);
maxGasIndex = max(gasIndex);
meanGasIndex = mean(gasIndex);

disp("=== Composite Index Analysis Summary ===");
summaryTable = table(avgTemp, meanGasIndex, maxGasIndex, ...
    'VariableNames', {'AvgTemp_C','MeanGasIndex_pct','MaxGasIndex_pct'});
disp(summaryTable);

disp("=== Composite Index Analysis last 5 rows ===");
disp(table(time(end-5:end), gasIndex(end-5:end), 'VariableNames', {'Time','GasIndex_pct'}));


```

Matlab Analysis script for Email Alert:

Name

Sending Email Alert

MATLAB Code

```
alertApiKey = "TAKmJi84oqIQvV+XJVL";
readChannelID = 3209217;
readKey = "4ZLNSW8A41U0UAJ6";
numPoints = 1;

th_mq2   = 600;
th_mq3   = 500;
th_mq6   = 380;
th_mq135 = 420;
th_temp  = 27.5;

%Read the newest point from the channel
fields = [1 2 3 4 5];
if strlength(readKey) > 0
    [data, t] = thingSpeakRead(readChannelID, "Fields", fields, "NumPoints", numPoints, "ReadKey", readKey);
else
    [data, t] = thingSpeakRead(readChannelID, "Fields", fields, "NumPoints", numPoints);
end

mq2   = data(end,1);
mq3   = data(end,2);
mq6   = data(end,3);
mq135 = data(end,4);
temp  = data(end,5);

reasons = strings(0);
if mq2   > th_mq2,   reasons(end+1) = "MQ-2 exceeded threshold";   end
if mq3   > th_mq3,   reasons(end+1) = "MQ-3 exceeded threshold";   end
if mq6   > th_mq6,   reasons(end+1) = "MQ-6 exceeded threshold";   end
if mq135 > th_mq135, reasons(end+1) = "MQ-135 exceeded threshold"; end
if temp  > th_temp,  reasons(end+1) = "Temperature exceeded threshold"; end

%--send an Email --
if isempty(reasons)
    fprintf("No alert conditions met. No email sent.\n");
    return;
end

mailSubject = "Air Monitor Alert: Threshold Exceeded";
```

```
mailSubject = "Air Monitor Alert: Threshold Exceeded";

mailBody = sprintf([ ...
    "Air Monitoring Alert Triggered\n\n" + ...
    "Time: %s\n\n" + ...
    "Readings:\n" + ...
    "MQ-2   = %.2f (th=%.2f)\n" + ...
    "MQ-3   = %.2f (th=%.2f)\n" + ...
    "MQ-6   = %.2f (th=%.2f)\n" + ...
    "MQ-135 = %.2f (th=%.2f)\n" + ...
    "Temp   = %.2f (th=%.2f)\n\n" + ...
    "Triggered because:\n- %s\n" ], ...
    string(t(end)), mq2, th_mq2, mq3, th_mq3, mq6, th_mq6, mq135, th_mq135, temp, th_temp, ...
    strjoin(reasons, newline + "- "));

alertUrl = "https://api.thingspeak.com/alerts/send";
options  = weboptions("HeaderFields", ["ThingSpeak-Alerts-API-Key", alertApiKey]);

response = webwrite(alertUrl, "subject", mailSubject, "body", mailBody, options);
disp(response);

fprintf("Email alert sent.\n");
```

Act on data:

Based on sensor data if the values exceed the safety threshold, an Alert email is sent specifying which sensor exceeded the safety threshold