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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

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MATLAB Code

```
1 readChannelID = 3209217;
2 readKey = '4ZLNSW8A41U0UAJ6';
3 fields = [1 2 3 4 5]; % MQ-2, MQ-3, MQ-6, MQ-135, Temperature
4 numPoints = 1000;
5
6 [raw_data, time] = thingSpeakRead(readChannelID, ...
7     'Fields', fields, ...
8     'NumPoints', numPoints, ...
9     'ReadKey', readKey);
10 cleanData = fillmissing(raw_data, 'linear');
11 data = movmean(cleanData, 5);
12 mq2 = data(:,1);
13 mq3 = data(:,2);
14 mq6 = data(:,3);
15 mq135 = data(:,4);
16 temp = data(:,5);
17
18 sensorNames = {'MQ-2','MQ-3','MQ-6','MQ-135','Temp'};
19
20 thresholds = [600, 500, 380, 420, 27.5];
21
22 % Classification: 1 = Alert, 0 = Normal
23 status = [
24     mq2 > thresholds(1), ...
25     mq3 > thresholds(2), ...
26     mq6 > thresholds(3), ...
27     mq135 > thresholds(4), ...
28     temp > thresholds(5)
29 ];
30
31 %Counts
32 alertCounts = sum(status);
33 normalCounts = numPoints - alertCounts;
34
35 analysisTable = table( ...
36     sensorNames', ...
37     thresholds', ...
38     normalCounts', ...
39     alertCounts', ...
40     'VariableNames', {'Sensor','Threshold','Normal_Count','Alert_Count'} ...
41 );
42
43 disp('--- Classification Analysis Results ---');
44 disp(analysisTable);
```

Name

Fill NA , Smoothing, Statistical Analysis (Correlation)

MATLAB Code

```
1 readChannelID = 3209217;
2 readKey = '4ZLNSW8A41U0UAJ6';
3 numPoints = 500;
4
5 [data, time] = thingSpeakRead(readChannelID, ...
6     'Fields', [1 2 3 4 5], ...
7     'NumPoints', numPoints, ...
8     'ReadKey', readKey);
9 %--Prepare(cleaning and smoothing)----
10 cleanData = fillmissing(data, 'linear');
11 smoothedData = movmean(cleanData, 5);
12
13 %---Analyze(statistical analysis correlation)---
14 mqData = smoothedData(:, 1:4);
15 sensorNames = {'MQ-2','MQ-3','MQ-6','MQ-135'};
16
17 R = corr(mqData, 'Rows', 'pairwise');
18
19 correlationTable = array2table(R, ...
20     'VariableNames', sensorNames, ...
21     'RowNames', sensorNames);
22
23 disp('--- Correlation Analysis Results ---');
24 disp(correlationTable);
25
26
27
```

## Remove NA, Normalize and Calculate Composite gas contamination index

MATLAB Code

```
1 readChannelID = 3209217;
2 fields = [1 2 3 4 5];           % MQ-2, MQ-3, MQ-6, MQ-135, Temperature
3 numPoints = 500;
4
5 [data, time] = thingSpeakRead(readChannelID, ...
6     "Fields", fields, ...
7     "NumPoints", numPoints);
8
9 % --- Prepare Technique (Remove missing values and Normalization) ---
10 validIdx = ~any(isnan(data), 2);
11 data = data(validIdx, :);
12 time = time(validIdx);
13
14 mq2    = data(:,1);
15 mq3    = data(:,2);
16 mq6    = data(:,3);
17 mq135 = data(:,4);
18 temp   = data(:,5);
19
20 %Normalization
21 norm01 = @(x) (x - min(x)) ./ max(max(x) - min(x), eps);
22
23 mq2_n  = norm01(mq2);
24 mq3_n  = norm01(mq3);
25 mq6_n  = norm01(mq6);
26 mq135_n = norm01(mq135);
27
28 % --- Analyze technique (Composite Gas Contamination Index) ---
29 gasIndex = 100 * mean([mq2_n mq3_n mq6_n mq135_n], 2);
30
31 avgTemp = mean(temp);
32 maxGasIndex = max(gasIndex);
33 meanGasIndex = mean(gasIndex);
34
35 disp("==> Composite Index Analysis Summary ==");
36 summaryTable = table(avgTemp, meanGasIndex, maxGasIndex, ...
37     'VariableNames', {'AvgTemp_C','MeanGasIndex_pct','MaxGasIndex_pct'});
38 disp(summaryTable);
39
40 disp("==> Composite Index Analysis last 5 rows ==");
41 disp(table(time(end-5:end), gasIndex(end-5:end), 'VariableNames', {'Time','GasIndex_pct'}));
42
43
```

Matlab Analysis script for Email Alert:

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Name

Sending Email Alert

MATLAB Code

```
1 alertApiKey = "TAKmJi84oqIQvV+XJVL";
2 readChannelID = 3209217;
3 readKey = "4ZLNSW8A41U0UAJ6";
4 numPoints = 1;
5
6 th_mq2    = 600;
7 th_mq3    = 500;
8 th_mq6    = 380;
9 th_mq135  = 420;
10 th_temp   = 27.5;
11
12 %Read the newest point from the channel
13 fields = [1 2 3 4 5];
14 if strlen(readKey) > 0
15     [data, t] = thingSpeakRead(readChannelID, "Fields", fields, "NumPoints", numPoints, "ReadKey", readKey);
16 else
17     [data, t] = thingSpeakRead(readChannelID, "Fields", fields, "NumPoints", numPoints);
18 end
19
20 mq2    = data(end,1);
21 mq3    = data(end,2);
22 mq6    = data(end,3);
23 mq135  = data(end,4);
24 temp   = data(end,5);
25
26 reasons = strings(0);
27 if mq2  > th_mq2,  reasons(end+1) = "MQ-2 exceeded threshold"; end
28 if mq3  > th_mq3,  reasons(end+1) = "MQ-3 exceeded threshold"; end
29 if mq6  > th_mq6,  reasons(end+1) = "MQ-6 exceeded threshold"; end
30 if mq135 > th_mq135, reasons(end+1) = "MQ-135 exceeded threshold"; end
31 if temp  > th_temp, reasons(end+1) = "Temperature exceeded threshold"; end
32
33 %%--send an Email --
34 if isempty(reasons)
35     fprintf("No alert conditions met. No email sent.\n");
36     return;
37 end
38
39 mailSubject = "Air Monitor Alert: Threshold Exceeded";
```

```

39 mailSubject = "Air Monitor Alert: Threshold Exceeded";
40
41 mailBody = sprintf([
42     "Air Monitoring Alert Triggered\n\n" +
43     "Time: %s\n\n" +
44     "Readings:\n" +
45     "MQ-2    = %.2f (th=%.2f)\n" +
46     "MQ-3    = %.2f (th=%.2f)\n" +
47     "MQ-6    = %.2f (th=%.2f)\n" +
48     "MQ-135 = %.2f (th=%.2f)\n" +
49     "Temp    = %.2f (th=%.2f)\n\n" +
50     "Triggered because:\n- %s\n", ...
51     string(t(end)), mq2, th_mq2, mq3, th_mq3, mq6, th_mq6, mq135, th_mq135, temp, th_temp, ...
52     strjoin(reasons, newline + "- "));
53
54 alertUrl = "https://api.thingspeak.com/alerts/send";
55 options = weboptions("HeaderFields", ["ThingSpeak-Alerts-API-Key", alertApiKey]);
56
57 response = webwrite(alertUrl, "subject", mailSubject, "body", mailBody, options);
58 disp(response);
59
60 fprintf("Email alert sent.\n");
61
62

```

## 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

Alert: Air Monitor Alert: Threshold Exceeded [Summarize](#)

TA ThingSpeak Alerts <thingspeak-alerts@mail.thingspeak.com> To: GANA SALEH MAHMOUD GHADIEH Sat 2025-12-20 00:55

You don't often get email from thingspeak-alerts@mail.thingspeak.com. [Learn why this is important](#)

Air Monitoring Alert Triggered Time: 20-Dec-2025



### Alert: Air Monitor Alert: Threshold Exceeded

Air Monitoring Alert Triggered

Time: 20-Dec-2025 10:39:13

Readings:

- MQ-2 = 633.00 (th=600.00)
- MQ-3 = 442.00 (th=500.00)
- MQ-6 = 402.00 (th=380.00)
- MQ-135 = 434.00 (th=420.00)
- Temp = 25.21 (th=27.50)

Triggered because:

- MQ-2 exceeded threshold
- MQ-6 exceeded threshold
- MQ-135 exceeded threshold

Time: 2025-12-20 08:55:997 :+0000

You are receiving this email because a ThingSpeak Alert was requested using your ThingSpeak Alerts API key. For more information please refer to the [ThingSpeak Alerts Documentation](#).

