

IoT Environmental Monitoring & Analytics Dashboard

An end-to-end pipeline from embedded sensor simulation to an interactive Power BI dashboard

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Overview

This project demonstrates a complete data pipeline that bridges hardware and analytics. I simulated an embedded sensor system, processed its output with a Python data pipeline, and delivered the results in an interactive Power BI dashboard. The goal was to monitor environmental conditions (temperature and humidity), detect when readings move outside safe operating thresholds, and surface the findings in a clear, decision-ready format.

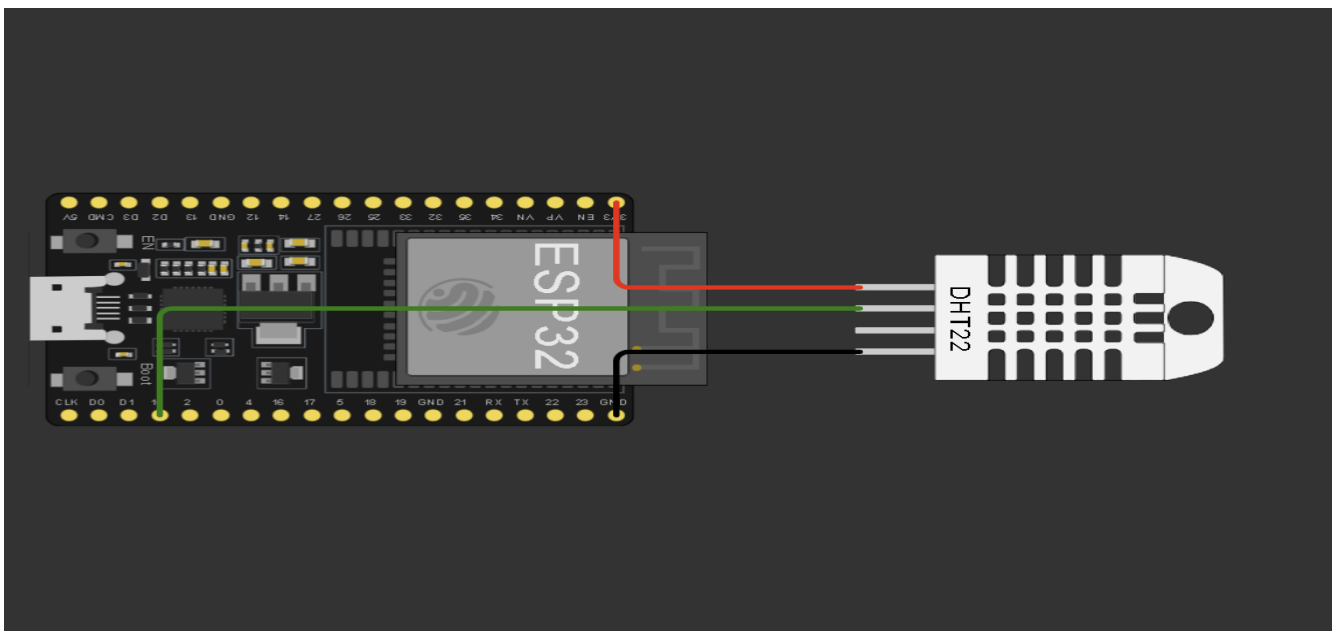
System Architecture

The solution follows a three-stage pipeline: Sensor Layer (ESP32 + DHT22, simulated in Wokwi) to Data Pipeline (Python cleaning and feature engineering) to Analytics Layer (interactive Power BI dashboard with DAX measures).

Methodology

1. Sensor simulation

An ESP32 board with a DHT22 sensor was built and programmed in the Wokwi simulator. The firmware generated realistic, time-varying temperature and humidity readings, output as structured CSV over the serial monitor. Over 400 readings were collected.



2. Data processing (Python)

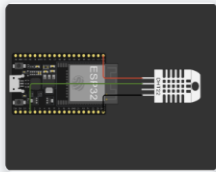
A Python pipeline (pandas, numpy) transformed the raw sensor output into an analysis-ready dataset:

- Filtered out microcontroller boot noise and kept only valid numeric readings
- Converted fields to proper numeric and datetime types
- Engineered 10-reading rolling averages to smooth sensor noise
- Applied threshold-based alert flags for out-of-range temperature and humidity
- Derived a status category (Normal, Warning, Critical) and a comfort indicator

3. Visualization (Power BI)

The clean dataset was modeled in Power BI. A custom DAX measure was authored to count critical events, and an interactive dashboard was built with KPI cards, time-series trend charts (raw vs. rolling average), a status breakdown donut, and a slicer for filtering by condition.

IoT Environmental Monitoring Dashboard



25.43

Average of temperature_C

39.24

Average of humidity_percent

27

Critical Events

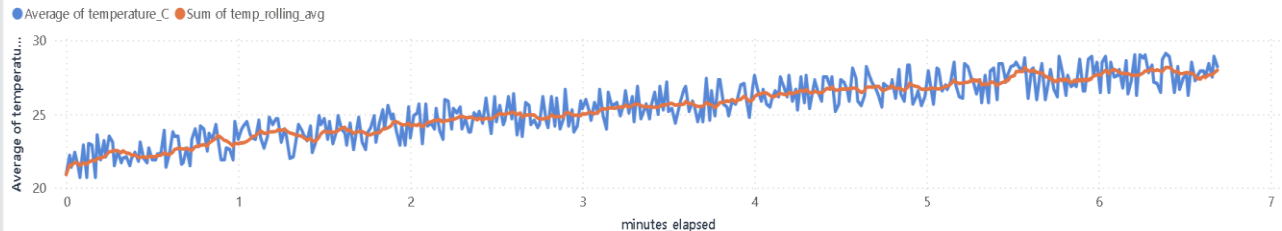
178

Sum of any_alert

Status

- ☐ Critical
- ☐ Normal
- ☐ Warning

Average of temperature_C and Sum of temp_rolling_avg by minutes_elapsed



Count of status by status



Key Findings

402

Readings Analyzed

25.43°C

Avg Temperature

41%

Readings In Alert

27

Critical Events

The analysis showed a clear environmental degradation over the monitoring window: as temperature climbed from roughly 21°C to 29°C, humidity fell from about 47% to 33%. Threshold monitoring flagged 41% of all readings as outside the safe temperature range, including 27 critical events where both temperature and humidity breached limits simultaneously. The rolling-average overlay made the underlying trend clear despite reading-to-reading noise.

Status Breakdown

Status	Readings	Share	Meaning
Normal	224	55.72%	Within safe operating range
Warning	151	37.56%	One metric out of range
Critical	27	6.72%	Both metrics out of range

Complete Dataset (402 Readings)

The full processed dataset is shown below: every one of the 402 sensor readings collected during the monitoring window, with engineered rolling averages and the derived status. Critical rows are shaded red and warning rows amber. This is the raw analytical foundation behind the dashboard KPIs and charts.

ID	Time (min)	Temp °C	Temp Avg	Humidity %	Hum Avg	Status
1	0.0	20.9	20.9	44.7	44.7	Normal
2	0.02	22.2	21.55	45.8	45.25	Warning
3	0.03	21.4	21.5	46.8	45.77	Warning
4	0.05	22.4	21.72	46.1	45.85	Warning
5	0.07	21.4	21.66	46.5	45.98	Warning
6	0.08	20.7	21.5	43.5	45.57	Normal
7	0.1	22.9	21.7	44.0	45.34	Normal
8	0.12	20.7	21.58	46.3	45.46	Warning
9	0.13	23.0	21.73	44.7	45.38	Normal

ID	Time (min)	Temp °C	Temp Avg	Humidity %	Hum Avg	Status
10	0.15	22.9	21.85	42.9	45.13	Normal
11	0.17	20.7	21.83	46.2	45.28	Warning
12	0.18	23.6	21.97	46.4	45.34	Warning
13	0.2	21.9	22.02	43.4	45.0	Normal
14	0.22	23.2	22.1	43.8	44.77	Normal
15	0.23	22.1	22.17	43.5	44.47	Normal
16	0.25	23.5	22.45	42.7	44.39	Normal
17	0.27	23.1	22.47	45.5	44.54	Warning
18	0.28	21.5	22.55	43.7	44.28	Normal
19	0.3	22.5	22.5	43.1	44.12	Normal
20	0.32	21.7	22.38	43.7	44.2	Normal
21	0.33	22.0	22.51	44.0	43.98	Normal
22	0.35	22.1	22.36	43.3	43.67	Normal
23	0.37	21.5	22.32	42.8	43.61	Normal
24	0.38	22.0	22.2	43.9	43.62	Normal
25	0.4	22.4	22.23	44.2	43.69	Normal
26	0.42	21.8	22.06	45.1	43.93	Warning
27	0.43	23.1	22.06	43.9	43.77	Normal
28	0.45	22.0	22.11	42.6	43.66	Normal
29	0.47	21.7	22.03	44.3	43.78	Normal
30	0.48	22.7	22.13	43.0	43.71	Normal
31	0.5	21.9	22.12	45.4	43.85	Warning
32	0.52	21.9	22.1	43.3	43.85	Normal
33	0.53	22.3	22.18	42.2	43.79	Normal
34	0.55	22.3	22.21	43.3	43.73	Normal
35	0.57	23.9	22.36	45.0	43.81	Normal
36	0.58	21.4	22.32	44.4	43.74	Normal
37	0.6	22.3	22.24	44.6	43.81	Normal
38	0.62	23.8	22.42	45.0	44.05	Normal
39	0.63	23.5	22.6	43.2	43.94	Normal
40	0.65	23.5	22.68	42.8	43.92	Normal
41	0.67	21.6	22.65	45.5	43.93	Warning
42	0.68	21.7	22.63	45.5	44.15	Warning
43	0.7	22.7	22.67	44.2	44.35	Normal
44	0.72	21.5	22.59	43.9	44.41	Normal
45	0.73	23.3	22.53	42.6	44.17	Normal
46	0.75	24.0	22.79	44.5	44.18	Normal
47	0.77	22.8	22.84	42.7	43.99	Normal
48	0.78	24.2	22.88	43.0	43.79	Normal
49	0.8	24.0	22.93	44.6	43.93	Normal
50	0.82	22.5	22.83	45.2	44.17	Warning
51	0.83	23.7	23.04	43.3	43.95	Normal
52	0.85	23.3	23.2	42.5	43.65	Normal
53	0.87	24.3	23.36	44.9	43.72	Normal
54	0.88	23.5	23.56	42.5	43.58	Normal
55	0.9	21.9	23.42	43.0	43.62	Normal
56	0.92	21.9	23.21	44.6	43.63	Normal
57	0.93	22.7	23.2	42.3	43.59	Normal
58	0.95	22.6	23.04	41.4	43.43	Normal
59	0.97	21.9	22.83	42.3	43.2	Normal
60	0.98	24.5	23.03	44.3	43.11	Normal
61	1.0	23.3	22.99	43.8	43.16	Normal
62	1.02	24.0	23.06	43.6	43.27	Normal
63	1.03	24.2	23.05	40.9	42.87	Normal
64	1.05	24.5	23.15	41.1	42.73	Normal
65	1.07	23.6	23.32	42.8	42.71	Normal
66	1.08	23.4	23.47	44.2	42.67	Normal
67	1.1	23.3	23.53	42.5	42.69	Normal
68	1.12	24.6	23.73	44.4	42.99	Normal
69	1.13	23.4	23.88	42.0	42.96	Normal
70	1.15	22.7	23.7	42.3	42.76	Normal
71	1.17	23.5	23.72	43.9	42.77	Normal
72	1.18	24.8	23.8	43.9	42.8	Normal
73	1.2	24.3	23.81	41.2	42.83	Normal
74	1.22	24.7	23.83	42.5	42.97	Normal
75	1.23	24.7	23.94	44.0	43.09	Normal
76	1.25	23.1	23.91	41.1	42.78	Normal
77	1.27	24.0	23.98	41.2	42.65	Normal
78	1.28	23.5	23.87	42.3	42.44	Normal
79	1.3	22.0	23.73	40.5	42.29	Normal
80	1.32	22.1	23.67	41.4	42.2	Normal
81	1.33	22.8	23.6	44.1	42.22	Normal
82	1.35	24.3	23.55	44.1	42.24	Normal
83	1.37	23.9	23.51	43.1	42.43	Normal
84	1.38	23.6	23.4	43.7	42.55	Normal
85	1.4	23.2	23.25	44.0	42.55	Normal
86	1.42	24.2	23.36	44.0	42.84	Normal
87	1.43	22.4	23.2	40.6	42.78	Normal
88	1.45	23.1	23.16	40.8	42.63	Normal
89	1.47	24.9	23.45	43.4	42.92	Normal
90	1.48	24.3	23.67	42.3	43.01	Normal
91	1.5	24.7	23.86	40.4	42.64	Normal

ID	Time (min)	Temp °C	Temp Avg	Humidity %	Hum Avg	Status
92	1.52	23.3	23.76	40.3	42.26	Normal
93	1.53	24.5	23.82	40.8	42.03	Normal
94	1.55	23.0	23.76	41.2	41.78	Normal
95	1.57	23.8	23.82	41.4	41.52	Normal
96	1.58	24.9	23.89	40.2	41.14	Normal
97	1.6	24.0	24.05	42.1	41.29	Normal
98	1.62	23.7	24.11	42.3	41.44	Normal
99	1.63	22.9	23.91	40.9	41.19	Normal
100	1.65	24.4	23.92	42.1	41.17	Normal
101	1.67	22.6	23.71	43.1	41.44	Normal
102	1.69	24.1	23.79	40.0	41.41	Normal
103	1.7	24.8	23.82	39.8	41.31	Normal
104	1.72	23.1	23.83	39.8	41.17	Normal
105	1.74	22.6	23.71	42.7	41.3	Normal
106	1.75	23.7	23.59	42.2	41.5	Normal
107	1.77	24.1	23.6	40.9	41.38	Normal
108	1.79	24.9	23.72	40.9	41.24	Normal
109	1.8	23.1	23.74	41.9	41.34	Normal
110	1.82	24.4	23.74	43.0	41.43	Normal
111	1.84	25.3	24.01	42.2	41.34	Normal
112	1.85	24.0	24.0	39.7	41.31	Normal
113	1.87	25.6	24.08	40.0	41.33	Normal
114	1.89	24.7	24.24	40.2	41.37	Normal
115	1.9	25.0	24.48	42.3	41.33	Normal
116	1.92	23.8	24.49	40.6	41.17	Normal
117	1.94	22.9	24.37	43.0	41.38	Normal
118	1.95	24.2	24.3	41.0	41.39	Normal
119	1.97	22.9	24.28	41.2	41.32	Normal
120	1.99	25.5	24.39	41.2	41.14	Normal
121	2.0	23.4	24.2	41.1	41.03	Normal
122	2.02	24.9	24.29	41.1	41.17	Normal
123	2.04	25.1	24.24	39.6	41.13	Normal
124	2.05	25.7	24.34	39.6	41.07	Normal
125	2.07	23.0	24.14	42.8	41.12	Normal
126	2.09	25.7	24.33	40.7	41.13	Normal
127	2.1	24.2	24.46	39.8	40.81	Normal
128	2.12	24.4	24.48	40.4	40.75	Normal
129	2.14	24.0	24.59	39.9	40.62	Normal
130	2.15	25.4	24.58	42.7	40.77	Normal
131	2.17	23.9	24.63	38.8	40.54	Normal
132	2.19	23.3	24.47	39.9	40.42	Normal
133	2.2	26.0	24.56	40.2	40.48	Normal
134	2.22	25.9	24.58	42.3	40.75	Normal
135	2.24	24.0	24.68	42.0	40.67	Normal
136	2.25	25.4	24.65	40.0	40.6	Normal
137	2.27	25.1	24.74	39.4	40.56	Normal
138	2.29	25.5	24.85	40.1	40.53	Normal
139	2.3	24.0	24.85	38.9	40.43	Normal
140	2.32	24.7	24.78	41.3	40.29	Normal
141	2.34	23.8	24.77	39.1	40.32	Normal
142	2.35	23.8	24.82	40.3	40.36	Normal
143	2.37	25.1	24.73	42.2	40.56	Normal
144	2.39	24.8	24.62	42.3	40.56	Normal
145	2.4	25.2	24.74	39.1	40.27	Normal
146	2.42	24.4	24.64	41.5	40.42	Normal
147	2.44	26.1	24.74	40.7	40.55	Warning
148	2.45	25.2	24.71	41.9	40.73	Normal
149	2.47	23.7	24.68	41.1	40.95	Normal
150	2.49	26.2	24.83	39.4	40.76	Warning
151	2.5	24.5	24.9	39.0	40.75	Normal
152	2.52	25.6	25.08	41.5	40.87	Normal
153	2.54	24.3	25.0	41.1	40.76	Normal
154	2.55	24.6	24.98	40.7	40.6	Normal
155	2.57	26.2	25.08	39.1	40.6	Warning
156	2.59	24.7	25.11	38.1	40.26	Normal
157	2.6	26.4	25.14	39.4	40.13	Warning
158	2.62	23.6	24.98	38.5	39.79	Normal
159	2.64	24.8	25.09	41.7	39.85	Normal
160	2.65	23.5	24.82	41.3	40.04	Normal
161	2.67	25.8	24.95	40.8	40.22	Normal
162	2.69	25.6	24.95	39.9	40.06	Normal
163	2.7	24.3	24.95	40.3	39.98	Normal
164	2.72	24.6	24.95	38.6	39.77	Normal
165	2.74	24.1	24.74	38.0	39.66	Normal
166	2.75	24.3	24.7	39.1	39.76	Normal
167	2.77	26.2	24.68	39.7	39.79	Warning
168	2.79	24.5	24.77	39.5	39.89	Normal
169	2.8	24.1	24.7	39.2	39.64	Normal
170	2.82	26.2	24.97	37.9	39.3	Warning
171	2.84	24.2	24.81	38.0	39.02	Normal
172	2.85	26.1	24.86	40.8	39.11	Warning
173	2.87	24.0	24.83	39.0	38.98	Normal

ID	Time (min)	Temp °C	Temp Avg	Humidity %	Hum Avg	Status
174	2.89	24.7	24.84	40.6	39.18	Normal
175	2.9	26.7	25.1	38.6	39.24	Warning
176	2.92	24.2	25.09	40.5	39.38	Normal
177	2.94	25.3	25.0	39.1	39.32	Normal
178	2.95	23.8	24.93	40.2	39.39	Normal
179	2.97	24.2	24.94	40.3	39.5	Normal
180	2.99	25.9	24.91	37.7	39.48	Normal
181	3.0	25.4	25.03	39.9	39.67	Normal
182	3.02	26.0	25.02	40.1	39.6	Normal
183	3.04	25.2	25.14	40.0	39.7	Normal
184	3.05	24.6	25.13	38.3	39.47	Normal
185	3.07	25.8	25.04	39.8	39.59	Normal
186	3.09	25.1	25.13	38.6	39.4	Normal
187	3.1	26.7	25.27	38.6	39.35	Warning
188	3.12	24.9	25.38	37.5	39.08	Normal
189	3.14	24.0	25.36	40.0	39.05	Normal
190	3.15	26.5	25.42	38.7	39.15	Warning
191	3.17	25.6	25.44	40.8	39.24	Normal
192	3.19	25.7	25.41	40.1	39.24	Normal
193	3.2	25.8	25.47	39.0	39.14	Normal
194	3.22	24.9	25.5	38.0	39.11	Normal
195	3.24	25.7	25.49	37.7	38.9	Normal
196	3.25	26.6	25.64	37.1	38.75	Warning
197	3.27	25.1	25.48	37.5	38.64	Normal
198	3.29	26.2	25.61	39.2	38.81	Warning
199	3.3	24.5	25.66	37.3	38.54	Normal
200	3.32	26.9	25.7	38.6	38.53	Warning
201	3.34	24.7	25.61	39.5	38.4	Normal
202	3.35	25.0	25.54	40.2	38.41	Normal
203	3.37	25.7	25.53	40.2	38.53	Normal
204	3.39	24.7	25.51	40.3	38.76	Normal
205	3.4	25.6	25.5	39.1	38.9	Normal
206	3.42	26.5	25.49	39.6	39.15	Warning
207	3.44	25.0	25.48	38.1	39.21	Normal
208	3.45	26.9	25.55	40.0	39.29	Warning
209	3.47	25.3	25.63	38.7	39.43	Normal
210	3.49	27.2	25.66	37.8	39.35	Warning
211	3.5	25.2	25.71	37.8	39.18	Normal
212	3.52	25.4	25.75	39.5	39.11	Normal
213	3.54	24.4	25.62	36.6	38.75	Normal
214	3.55	24.9	25.64	37.5	38.47	Normal
215	3.57	25.9	25.67	39.1	38.47	Normal
216	3.59	26.7	25.69	40.1	38.52	Warning
217	3.6	26.9	25.88	38.4	38.55	Warning
218	3.62	25.2	25.71	39.8	38.53	Normal
219	3.64	25.9	25.77	36.8	38.34	Normal
220	3.65	25.6	25.61	37.4	38.3	Normal
221	3.67	24.5	25.54	40.0	38.52	Normal
222	3.69	25.4	25.54	37.6	38.33	Normal
223	3.7	24.5	25.55	39.9	38.66	Normal
224	3.72	27.4	25.8	37.7	38.68	Warning
225	3.74	24.6	25.67	37.1	38.48	Normal
226	3.75	26.6	25.66	36.7	38.14	Warning
227	3.77	24.9	25.46	37.7	38.07	Normal
228	3.79	27.3	25.67	39.4	38.03	Warning
229	3.8	27.3	25.81	36.5	38.0	Warning
230	3.82	25.7	25.82	40.0	38.26	Normal
231	3.84	25.5	25.92	39.8	38.24	Normal
232	3.85	24.9	25.87	36.6	38.14	Normal
233	3.87	25.9	26.01	39.5	38.1	Normal
234	3.89	25.7	25.84	37.5	38.08	Normal
235	3.9	26.0	25.98	38.5	38.22	Normal
236	3.92	27.0	26.02	38.9	38.44	Warning
237	3.94	27.1	26.24	39.6	38.63	Warning
238	3.95	26.2	26.13	38.1	38.5	Warning
239	3.97	24.8	25.88	36.5	38.5	Normal
240	3.99	26.9	26.0	38.3	38.33	Warning
241	4.0	27.6	26.21	36.0	37.95	Warning
242	4.02	26.6	26.38	38.2	38.11	Warning
243	4.04	25.9	26.38	36.6	37.82	Normal
244	4.05	26.7	26.48	39.5	38.02	Warning
245	4.07	25.7	26.45	37.6	37.93	Normal
246	4.09	25.5	26.3	37.7	37.81	Normal
247	4.1	26.0	26.19	36.7	37.52	Normal
248	4.12	26.6	26.23	37.3	37.44	Warning
249	4.14	26.2	26.37	36.4	37.43	Warning
250	4.15	27.5	26.43	38.9	37.49	Warning
251	4.17	26.9	26.36	35.9	37.48	Warning
252	4.19	26.2	26.32	37.0	37.36	Warning
253	4.2	27.6	26.49	38.5	37.55	Warning
254	4.22	25.9	26.41	36.7	37.27	Normal
255	4.24	26.7	26.51	39.1	37.42	Warning

ID	Time (min)	Temp °C	Temp Avg	Humidity %	Hum Avg	Status
256	4.25	25.3	26.49	36.7	37.32	Normal
257	4.27	27.5	26.64	37.3	37.38	Warning
258	4.29	25.8	26.56	39.3	37.58	Normal
259	4.3	27.6	26.7	38.4	37.78	Warning
260	4.32	25.4	26.49	39.1	37.8	Normal
261	4.34	26.7	26.47	38.5	38.06	Warning
262	4.35	27.3	26.58	37.6	38.12	Warning
263	4.37	26.5	26.47	37.1	37.98	Warning
264	4.39	25.9	26.47	38.8	38.19	Normal
265	4.4	27.5	26.55	35.3	37.81	Warning
266	4.42	27.5	26.77	39.1	38.05	Warning
267	4.44	26.9	26.71	37.0	38.02	Warning
268	4.45	27.5	26.88	36.5	37.74	Warning
269	4.47	25.2	26.64	38.8	37.78	Normal
270	4.49	25.7	26.67	38.4	37.71	Normal
271	4.5	27.3	26.73	38.9	37.75	Warning
272	4.52	27.2	26.72	36.2	37.61	Warning
273	4.54	26.6	26.73	38.6	37.76	Warning
274	4.55	25.9	26.73	35.3	37.41	Normal
275	4.57	28.1	26.79	36.9	37.57	Warning
276	4.59	27.4	26.78	38.7	37.53	Warning
277	4.6	25.9	26.68	37.8	37.61	Normal
278	4.62	25.6	26.49	37.5	37.71	Normal
279	4.64	26.3	26.6	37.0	37.53	Warning
280	4.65	28.2	26.85	37.5	37.44	Warning
281	4.67	27.5	26.87	35.9	37.14	Warning
282	4.69	27.0	26.85	37.5	37.27	Warning
283	4.7	26.9	26.88	38.8	37.29	Warning
284	4.72	26.3	26.92	37.0	37.46	Warning
285	4.74	25.5	26.66	34.9	37.26	Warning
286	4.75	27.1	26.63	38.5	37.24	Warning
287	4.77	26.9	26.73	35.0	36.96	Warning
288	4.79	26.8	26.85	37.6	36.97	Warning
289	4.8	27.3	26.95	37.2	36.99	Warning
290	4.82	26.1	26.74	35.5	36.79	Warning
291	4.84	28.0	26.79	35.5	36.75	Warning
292	4.85	26.4	26.73	38.1	36.81	Warning
293	4.87	25.9	26.63	35.7	36.5	Normal
294	4.89	28.3	26.83	36.1	36.41	Warning
295	4.9	28.3	27.11	34.8	36.4	Critical
296	4.92	25.7	26.97	35.3	36.08	Normal
297	4.94	26.2	26.9	35.0	36.08	Warning
298	4.95	26.6	26.88	35.7	35.89	Warning
299	4.97	25.6	26.71	36.6	35.83	Normal
300	4.99	26.2	26.72	36.7	35.95	Warning
301	5.01	27.9	26.71	37.2	36.12	Warning
302	5.02	27.2	26.79	38.0	36.11	Warning
303	5.04	25.7	26.77	37.4	36.28	Normal
304	5.06	28.1	26.75	37.1	36.38	Warning
305	5.07	28.0	26.72	36.6	36.56	Warning
306	5.09	26.6	26.81	37.7	36.8	Warning
307	5.11	27.0	26.89	36.0	36.9	Warning
308	5.12	26.7	26.9	37.6	37.09	Warning
309	5.14	27.2	27.06	36.8	37.11	Warning
310	5.16	28.5	27.29	35.5	36.99	Warning
311	5.17	27.0	27.2	35.7	36.84	Warning
312	5.19	26.2	27.1	36.6	36.7	Warning
313	5.21	26.1	27.14	35.9	36.55	Warning
314	5.22	28.4	27.17	37.4	36.58	Warning
315	5.24	28.2	27.19	34.3	36.35	Critical
316	5.26	27.4	27.27	37.2	36.3	Warning
317	5.27	27.3	27.3	36.6	36.36	Warning
318	5.29	26.4	27.27	37.8	36.38	Warning
319	5.31	27.3	27.28	34.5	36.15	Critical
320	5.32	25.8	27.01	35.7	36.17	Normal
321	5.34	27.6	27.07	34.9	36.09	Critical
322	5.36	25.8	27.03	36.2	36.05	Normal
323	5.37	27.9	27.21	37.5	36.21	Warning
324	5.39	28.1	27.18	35.0	35.97	Warning
325	5.41	26.0	26.96	36.0	36.14	Normal
326	5.42	28.4	27.06	35.4	35.96	Warning
327	5.44	28.4	27.17	34.1	35.71	Critical
328	5.46	27.2	27.25	38.0	35.73	Warning
329	5.47	27.6	27.28	37.0	35.98	Warning
330	5.49	28.2	27.52	34.1	35.82	Critical
331	5.51	28.3	27.59	35.0	35.83	Warning
332	5.52	28.5	27.86	35.1	35.72	Warning
333	5.54	28.1	27.88	34.7	35.44	Critical
334	5.56	28.0	27.87	35.0	35.44	Warning
335	5.57	28.8	28.15	37.3	35.57	Warning
336	5.59	26.1	27.92	35.2	35.55	Warning
337	5.61	28.0	27.88	37.1	35.85	Warning

ID	Time (min)	Temp °C	Temp Avg	Humidity %	Hum Avg	Status
338	5.62	28.1	27.97	36.8	35.73	Warning
339	5.64	26.0	27.81	36.5	35.68	Normal
340	5.66	27.8	27.77	34.7	35.74	Critical
341	5.67	28.4	27.78	36.6	35.9	Warning
342	5.69	26.0	27.53	35.3	35.92	Normal
343	5.71	27.3	27.45	36.3	36.08	Warning
344	5.72	28.0	27.45	37.5	36.33	Warning
345	5.74	26.7	27.24	37.7	36.37	Warning
346	5.76	26.2	27.25	36.5	36.5	Warning
347	5.77	28.9	27.34	35.8	36.37	Warning
348	5.79	27.8	27.31	36.0	36.29	Warning
349	5.81	26.3	27.34	37.5	36.39	Warning
350	5.82	27.6	27.32	34.3	36.35	Critical
351	5.84	26.9	27.17	37.0	36.39	Warning
352	5.86	27.1	27.28	34.4	36.3	Critical
353	5.87	26.9	27.24	36.1	36.28	Warning
354	5.89	28.7	27.31	34.4	35.97	Critical
355	5.91	26.6	27.3	34.6	35.66	Critical
356	5.92	26.6	27.34	33.7	35.38	Critical
357	5.94	28.7	27.32	37.4	35.54	Warning
358	5.96	28.9	27.43	35.5	35.49	Warning
359	5.97	27.6	27.56	35.8	35.32	Warning
360	5.99	28.5	27.65	35.6	35.45	Warning
361	6.01	26.5	27.61	35.5	35.3	Warning
362	6.02	28.5	27.75	33.7	35.23	Critical
363	6.04	28.9	27.95	33.7	34.99	Critical
364	6.06	26.5	27.73	37.5	35.3	Warning
365	6.07	28.5	27.92	37.4	35.58	Warning
366	6.09	27.5	28.01	36.2	35.83	Warning
367	6.11	27.6	27.9	34.8	35.57	Critical
368	6.12	28.0	27.81	33.6	35.38	Critical
369	6.14	26.8	27.73	34.3	35.23	Critical
370	6.16	28.6	27.74	35.9	35.26	Warning
371	6.17	26.4	27.73	35.0	35.21	Warning
372	6.19	27.3	27.61	37.3	35.57	Warning
373	6.21	29.0	27.62	35.4	35.74	Warning
374	6.22	26.3	27.6	37.1	35.7	Warning
375	6.24	29.0	27.65	34.5	35.41	Critical
376	6.26	28.8	27.78	33.9	35.18	Critical
377	6.27	29.0	27.92	37.3	35.43	Warning
378	6.29	27.8	27.9	37.0	35.77	Warning
379	6.31	28.3	28.05	33.7	35.71	Critical
380	6.32	27.2	27.91	35.0	35.62	Warning
381	6.34	27.1	27.98	36.5	35.77	Warning
382	6.36	26.5	27.9	36.3	35.67	Warning
383	6.37	28.7	27.87	36.2	35.75	Warning
384	6.39	29.1	28.15	36.6	35.7	Warning
385	6.41	28.9	28.14	37.1	35.96	Warning
386	6.42	28.3	28.09	34.1	35.98	Critical
387	6.44	26.5	27.84	35.0	35.75	Warning
388	6.46	28.2	27.88	34.0	35.45	Critical
389	6.47	26.7	27.72	34.1	35.49	Critical
390	6.49	27.4	27.74	36.6	35.65	Warning
391	6.51	27.7	27.8	36.4	35.64	Warning
392	6.52	26.3	27.78	35.7	35.58	Warning
393	6.54	28.5	27.76	37.0	35.66	Warning
394	6.56	27.3	27.58	35.0	35.5	Warning
395	6.57	27.5	27.44	33.9	35.18	Critical
396	6.59	27.9	27.4	35.3	35.3	Warning
397	6.61	27.9	27.54	36.9	35.49	Warning
398	6.62	27.5	27.47	37.1	35.8	Warning
399	6.64	28.4	27.64	34.5	35.84	Critical
400	6.66	27.5	27.65	36.7	35.85	Warning
401	6.67	28.9	27.77	36.3	35.84	Warning
402	6.69	28.2	27.96	33.4	35.61	Critical

Tools & Skills Demonstrated

Power BI, DAX, Python, pandas, data cleaning, data visualization, ESP32 / embedded systems, IoT, threshold monitoring, and end-to-end pipeline design.

Conclusion

This project demonstrates the full journey from a physical sensor signal to a business-ready analytics dashboard. It combines an engineering foundation (embedded systems and sensor data) with applied data skills (Python processing and Power BI visualization), showing the ability to design and deliver a complete monitoring solution rather than an isolated piece. The same pattern, collect, process, flag, and visualize, applies directly to operational reporting, equipment monitoring, and business intelligence use cases.