

Instituto Politécnico de Bragança
Mestrado em Engenharia Eletrotécnica e de Computadores

Uso de Arquitetura IoT com e-Nose para Monitoramento de Azeite de Oliva durante o Armazenamento

Trabalho para a disciplina de Internet das Coisas
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Azeite de Oliva

- Qualidade sensorial
- Produto sensível à oxidação e volatilização



Problemas durante o Armazenamento

- Perda de compostos voláteis
- Oxidação por luz, oxigênio, temperatura
- Soluções disponíveis



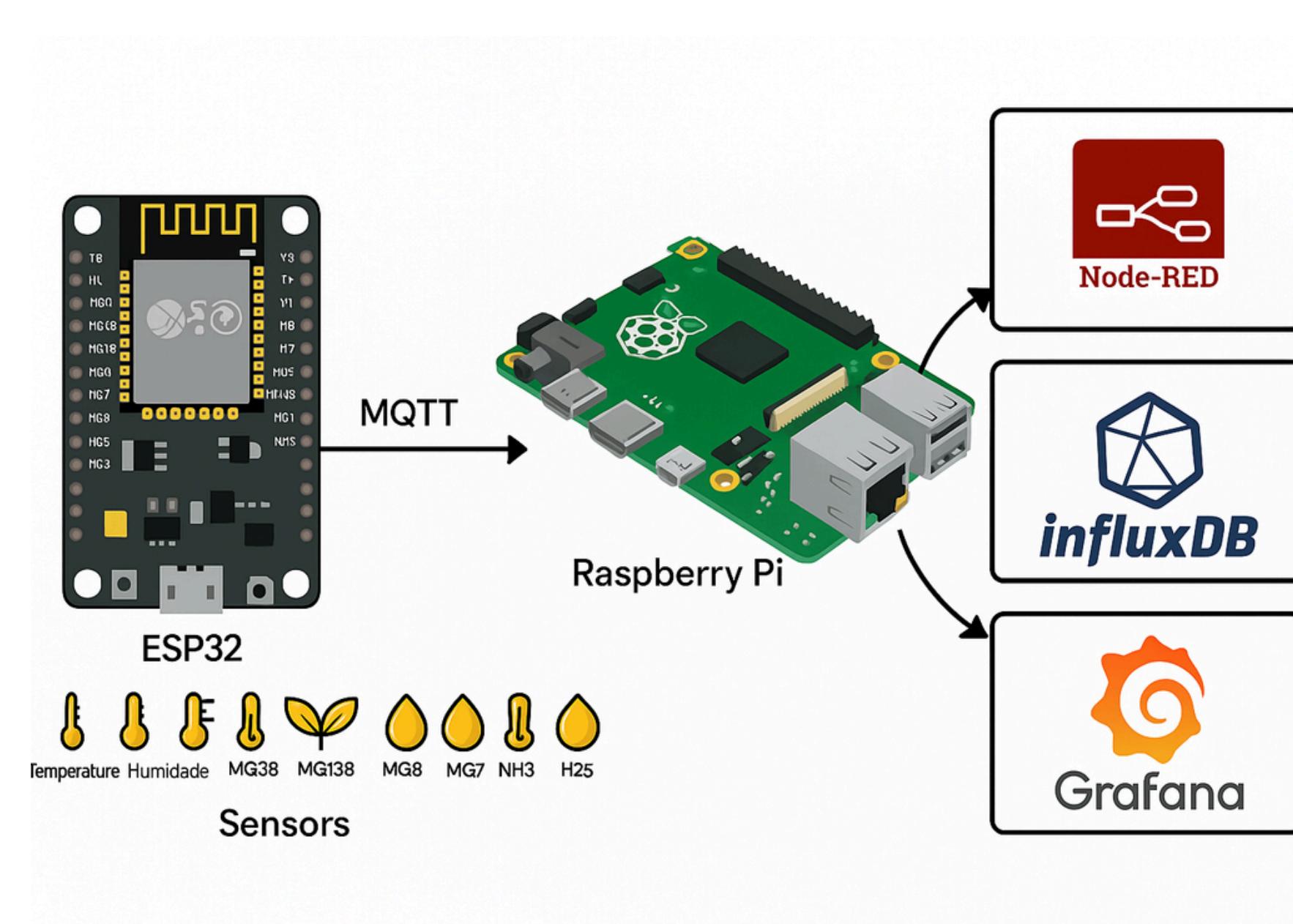
Nariz eletrônico (e-Nose)

- Microcontrolador: ESP32-DEVKITC v4
- Sensores utilizados: DHT22, MQ3, MG811, MQ138, MQ8, MQ7, MQ135, MQ4, NH3, H2S

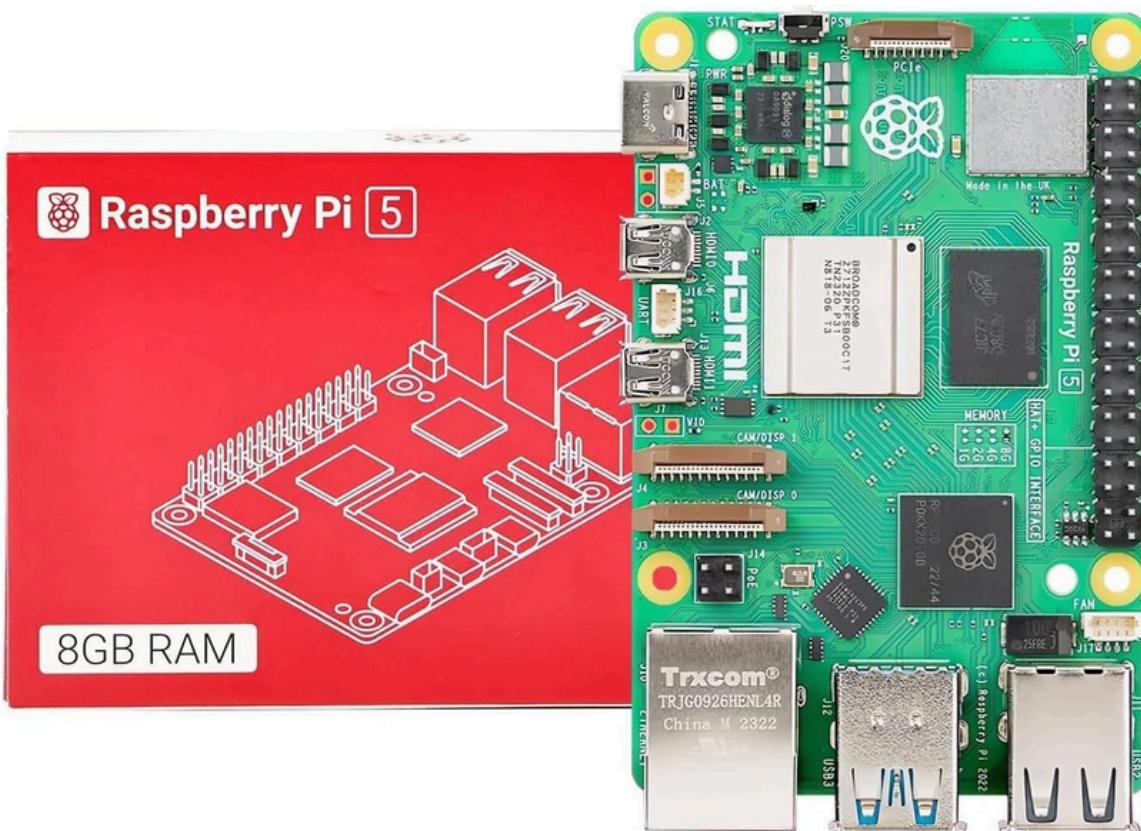


Arquitetura IoT do Projeto

- Recebe, armazena e exibe dados



Servidor (Raspberry Pi 5)



```
0[          0.0%] Tasks: 28, 49 thr, 116 kthr; 1 running
1[          0.0%] Load average: 0.00 0.00 0.00
2[          0.0%] Uptime: 3 days, 20:24:47
3[          1.3%]
Mem[ 438M/7.87G] 438M/512M
Swp[          0K/512M]

Main I/O PID USER PRI NI VIRT RES SHR S CPU%MEM% TIME+ Command
1 root 20 0 165M 10976 8016 S 0.0 0.1 0:04.01 /sbin/init
297 root 20 0 48464 20656 19632 S 0.0 0.3 0:35.47 /lib/systemd/systemd-journald
315 root 20 0 26800 6256 4208 S 0.0 0.1 0:00.35 /lib/systemd/systemd-udevd
476 systemd-ti 20 0 91072 6352 5328 S 0.0 0.1 0:00.98 /lib/systemd/systemd-timesyncd
513 systemd-ti 20 0 91072 6352 5328 S 0.0 0.1 0:00.00 /lib/systemd/systemd-timesyncd
514 avahi 20 0 7600 3104 2592 S 0.0 0.0 0:09.17 avahi-daemon: running [raspberrypi.local]
515 root 20 0 13648 5792 4768 S 0.0 0.1 0:00.02 /usr/libexec/bluetooth/bluetooth
516 root 20 0 6880 2144 2144 S 0.0 0.0 0:00.28 /usr/sbin/cron -f
517 messagebus 20 0 9056 3152 2640 S 0.0 0.0 0:04.13 /usr/bin/dbus-daemon --system --address=/systemd: --nofork --nopidfile --systemd-activation --syslog-only
524 pi 20 0 1097M 125M 40000 S 0.0 1.6 16:59.24 node-red
525 polkitd 20 0 230M 6368 5344 S 0.0 0.1 0:00.01 /usr/lib/polkit-1/polkitd --no-debug
528 root 20 0 17520 7504 5968 S 0.0 0.1 0:00.37 /lib/systemd/systemd-logind
529 nobody 20 0 6832 2800 2800 S 0.0 0.0 0:01.09 /usr/sbin/thd --triggers /etc/triggerhappy/triggers.d --socket /run/thd.socket --user nobody --deviceglob /dev/input/event*
532 avahi 20 0 7424 1616 1104 S 0.0 0.0 0:00.00 avahi-daemon: chroot helper
589 polkitd 20 0 230M 6368 5344 S 0.0 0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
590 polkitd 20 0 230M 6368 5344 S 0.0 0.1 0:00.01 /usr/lib/polkit-1/polkitd --no-debug
591 root 20 0 257M 18848 15264 S 0.0 0.2 0:24.00 /usr/sbin/NetworkManager --no-daemon
603 root 20 0 244M 11552 8488 S 0.0 0.1 0:00.04 /usr/sbin/ModemManager
611 root 20 0 244M 11552 8488 S 0.0 0.1 0:00.00 /usr/sbin/ModemManager
613 root 20 0 244M 11552 8488 S 0.0 0.1 0:00.00 /usr/sbin/ModemManager
614 root 20 0 257M 18848 15264 S 0.0 0.2 0:03.84 /usr/sbin/NetworkManager --no-daemon
615 root 20 0 257M 18848 15264 S 0.0 0.2 0:03.09 /usr/sbin/NetworkManager --no-daemon
624 root 20 0 5744 1584 1584 S 0.0 0.0 0:00.32 /sbin/agetty -o -p -- \u0000 --noclear - linux
625 root 20 0 5360 1552 1552 S 0.0 0.0 0:00.35 /sbin/agetty -o -p -- \u0000 --keep-baud 115200,57600,38400,9600 - vt220
631 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:00.00 node-red
632 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:17.99 node-red
633 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:17.94 node-red
634 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:17.96 node-red
635 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:17.98 node-red
640 dnsmasq 20 0 15168 2048 1536 S 0.0 0.0 0:00.14 /usr/sbin/dnsmasq -x /run/dnsmasq/dnsmasq.pid -u dnsmasq -7 /etc/dnsmasq.d,.dpkg-dist,.dpkg-old,.dpkg-new --local-service --trust-anchor=.203
647 root 20 0 16816 7968 6432 S 0.0 0.1 0:00.01 sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups
654 root 20 0 17776 11056 9008 S 0.0 0.1 0:01.30 /sbin/wpa_supplicant -u -s -0 DIR=/run/wpa_supplicant GROUP=netdev
659 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:00.00 node-red
665 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:00.03 node-red
666 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:00.04 node-red
667 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:00.02 node-red
668 pi 20 0 1097M 125M 40000 S 0.0 1.6 0:00.03 node-red
725 influxdb 20 0 1633M 172M 72848 S 0.0 2.1 12:45.99 /usr/bin/influxd
727 influxdb 20 0 1633M 172M 72848 S 0.0 2.1 1:06.64 /usr/bin/influxd
730 influxdb 20 0 1633M 172M 72848 S 0.0 2.1 1:16.95 /usr/bin/influxd
```

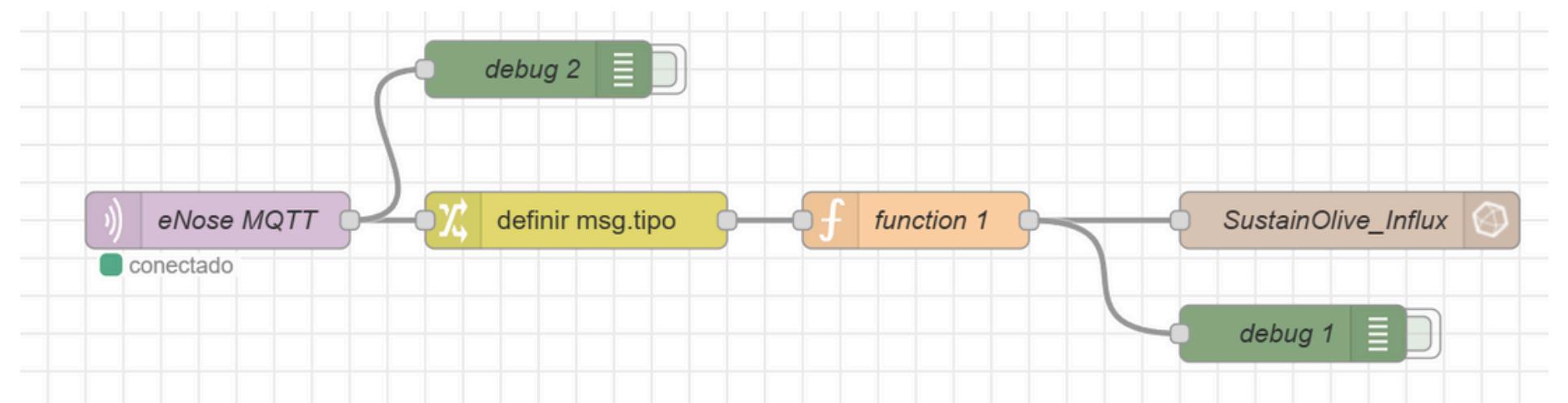
Node-red (fluxo de dados)

Propriedades

Servidor: EMQX Public
Ação: Assinar um tópico único
Tópico: SustainOlive/eNose/Najla
QoS: 0
Saída: auto-detecção(objeto JSON, cadeia de caracteres ou armazenamento temporário anal
Nome: eNose MQTT

04/06/2025, 17:06:01 nó: debug 2
SustainOlive/eNose/Najla : msg.payload : Object

object
temperatura: 39.4
umidade: 31.5
mq: array[9]
0: 0
1: 4094
2: 0
3: 162
4: 111
5: 140
6: 558
7: 0
8: 564



InfluxDB

Editar influx batch nó

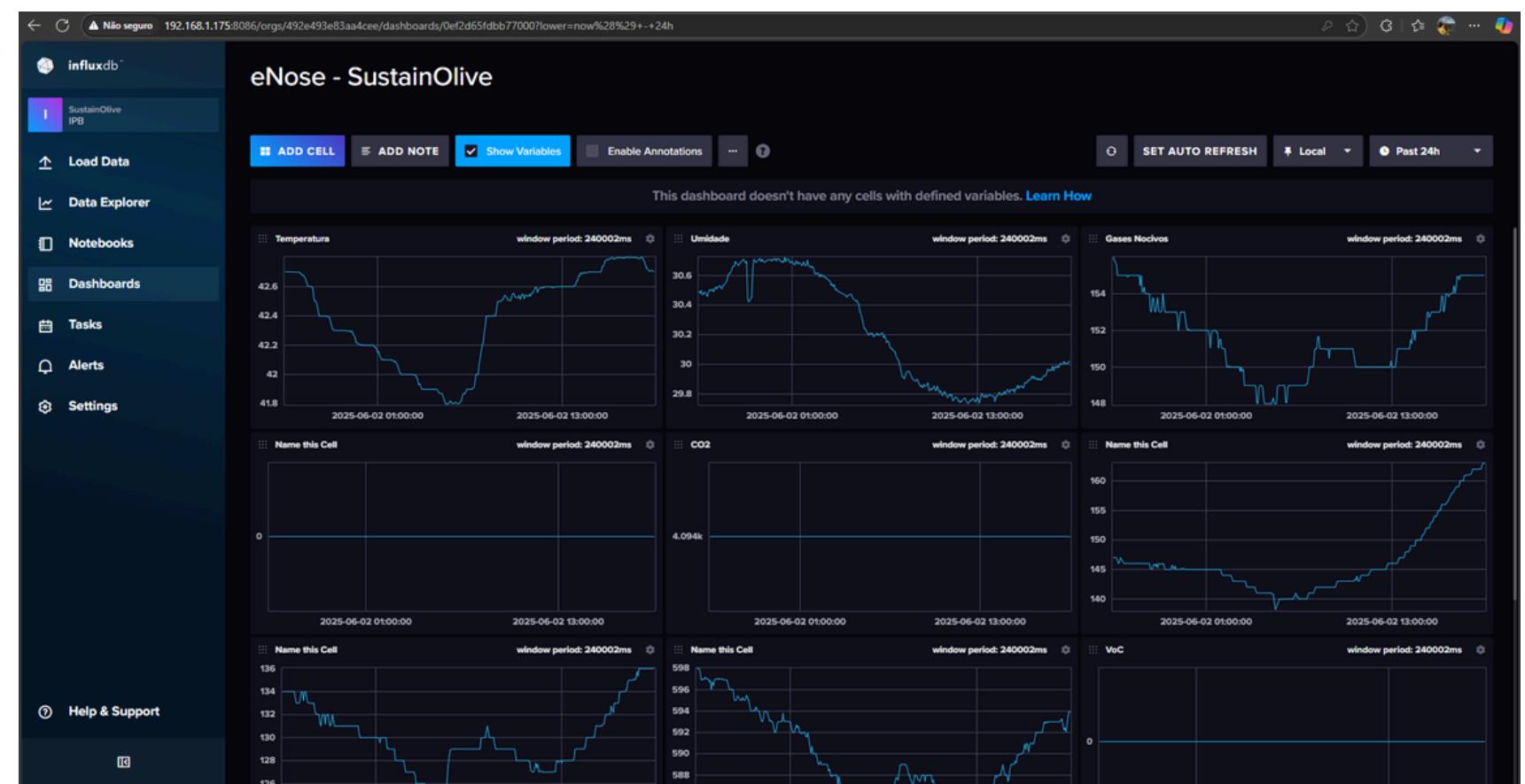
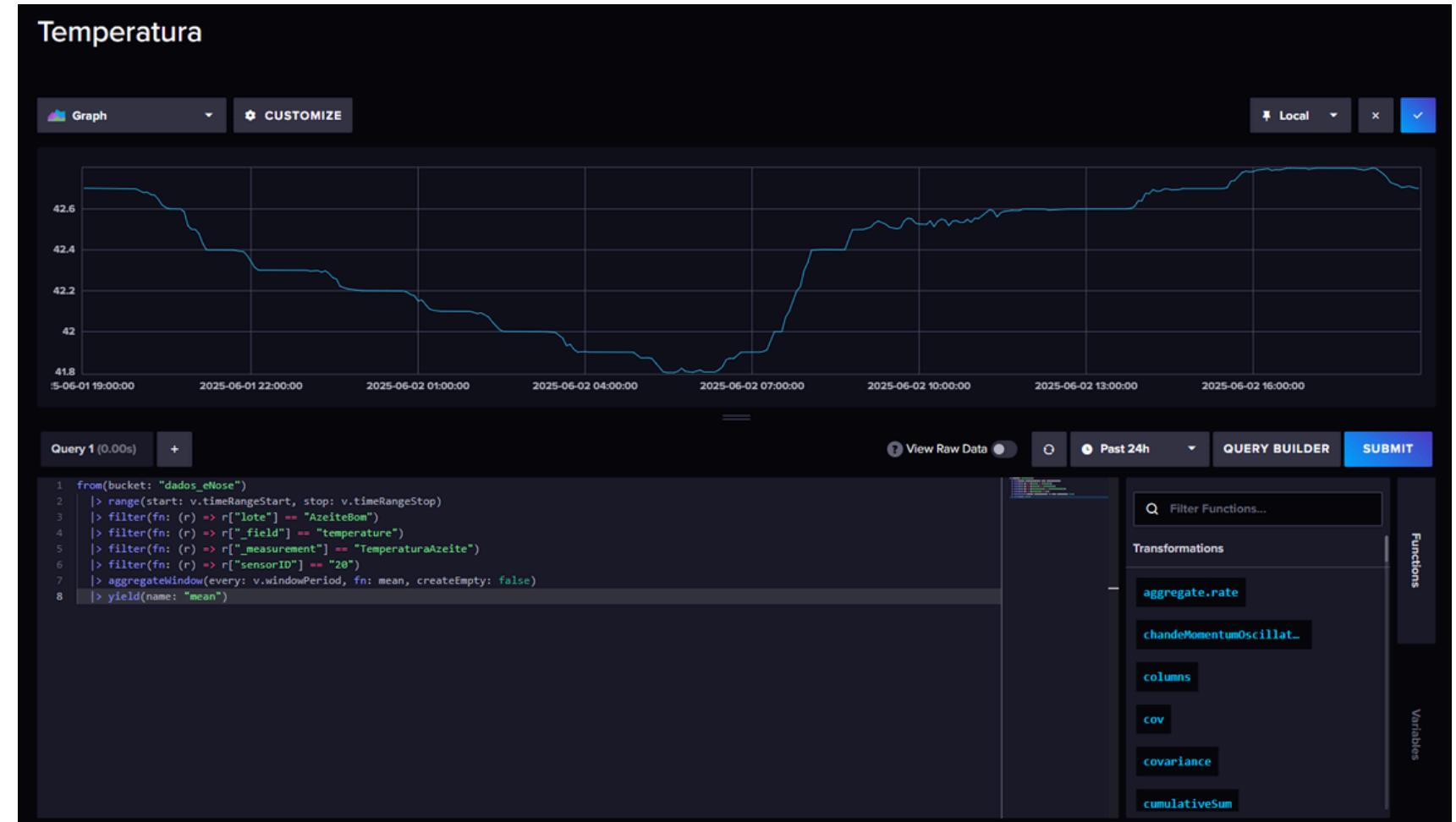
Deletar
Cancelar
Feito

Propriedades

 Nome	SustainOlive_Influx			
 Server	[v2.0] SustainOlive_Influx			
 Organization	IPB			
 Bucket	dados_eNose			
 Time Precision	Milliseconds (ms)			

Propriedades

 Nome	SustainOlive_Influx		
 Version	2.0		
 URL	http://localhost:8086		
 Token		
 Connection timeout (seconds)	10		
<input checked="" type="checkbox"/> Verify server certificate			



Visualização de dados - Grafana



Conclusão

- O sistema funciona de forma integrada e acessível
- Alternativa de baixo custo para controle de qualidade do azeite
- Próximos passos: incorporar alertas, exportar relatórios

