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Are we really making the most of our smart home technology?

Joyce Lin
Head of Developer Relations at Viam
joycejetson | viamrobotics

SoCal Linux Expo 2025

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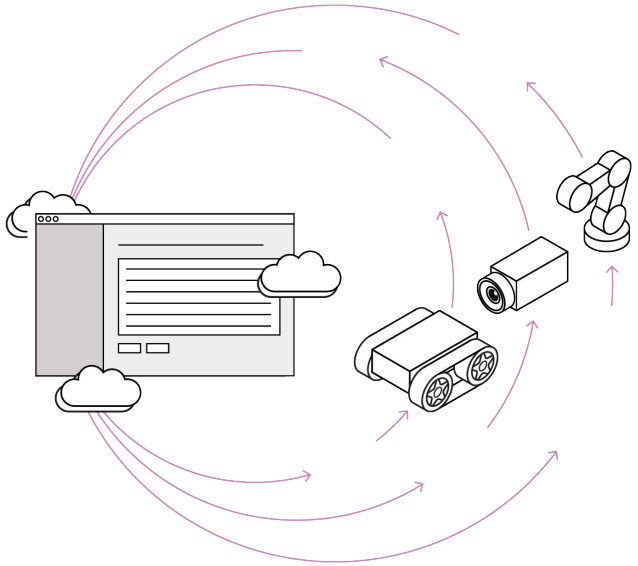
Joyce Lin

Head of Developer Relations, Viam

joycejetson | viamrobotics



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Are we really making the most of our smart home technology?

- **History** of smart homes
- Choosing the right **sensors**
- Choosing the right **actuators**
- Choosing the right **software and AI**
- Making **smarter** automations

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What is a
smart home?

?

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What is a smart ~~home~~ device?

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1990

- Sunbeam Deluxe Automatic Radiant Control Toaster
- Connected to the internet
- On and Off

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1997

- Wi-fi
- 2 Mbps
- Routers, adapters

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1999

- Z-wave
  - Low-power, wireless
  - Reliable, long-range
  - Proprietary until 2016

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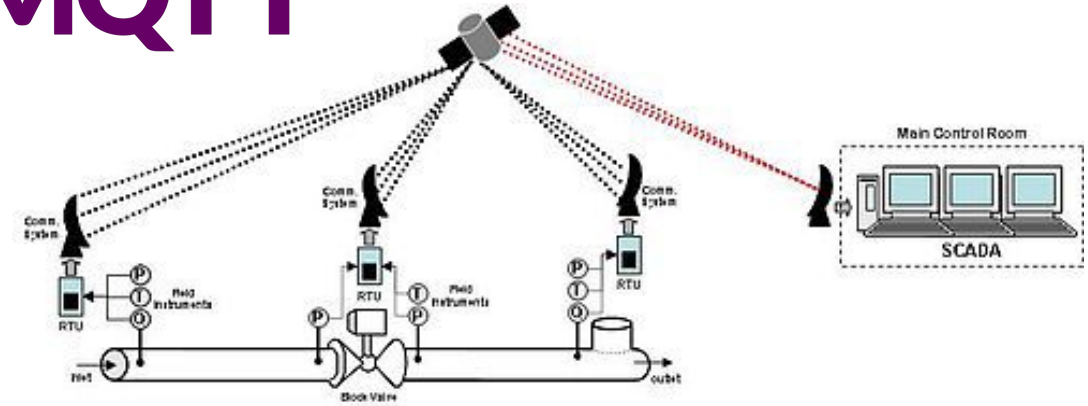
1999

- Z-wave
  - Low-power, wireless
  - Reliable, long-range
  - Proprietary until 2016
- MQTT
  - Low-power, low-bandwidth
  - Broker for pub/sub



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2003

zigbee

- Zigbee
- Low-power
- Mesh networking

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2007

- iPhone
- Smart phone with internet capabilities
- Mobile apps for mobile control

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2008

- Ecobee smart thermostat
- Wi-fi-enabled
- Web interface for remote control
- Monitoring and adjusting

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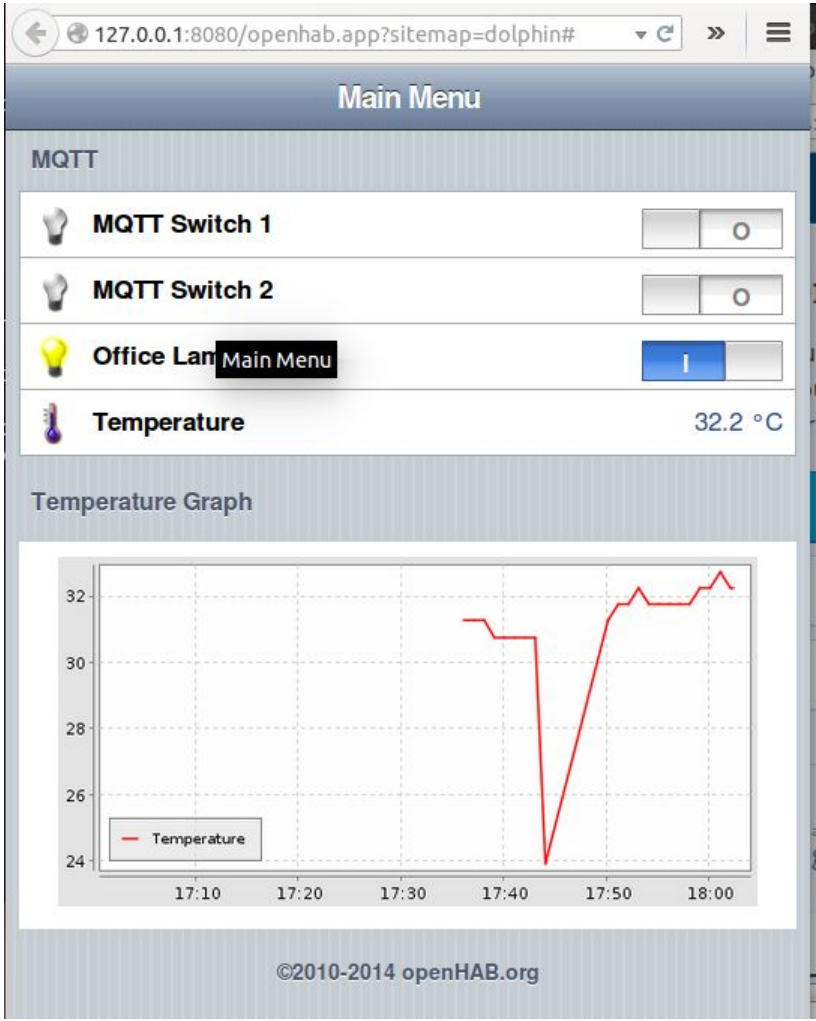
2010

- OpenHAB
- Open-source platform
- Multi-protocol (Zigbee, Z-Wave, MQTT)
- Local control, privacy



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2010

- Nest learning thermostat
- Self-learning to reduce manual control
- Energy efficiency

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2011

- Siri released to the public
- Voice assistant
- Natural language control
- Hands-free automation

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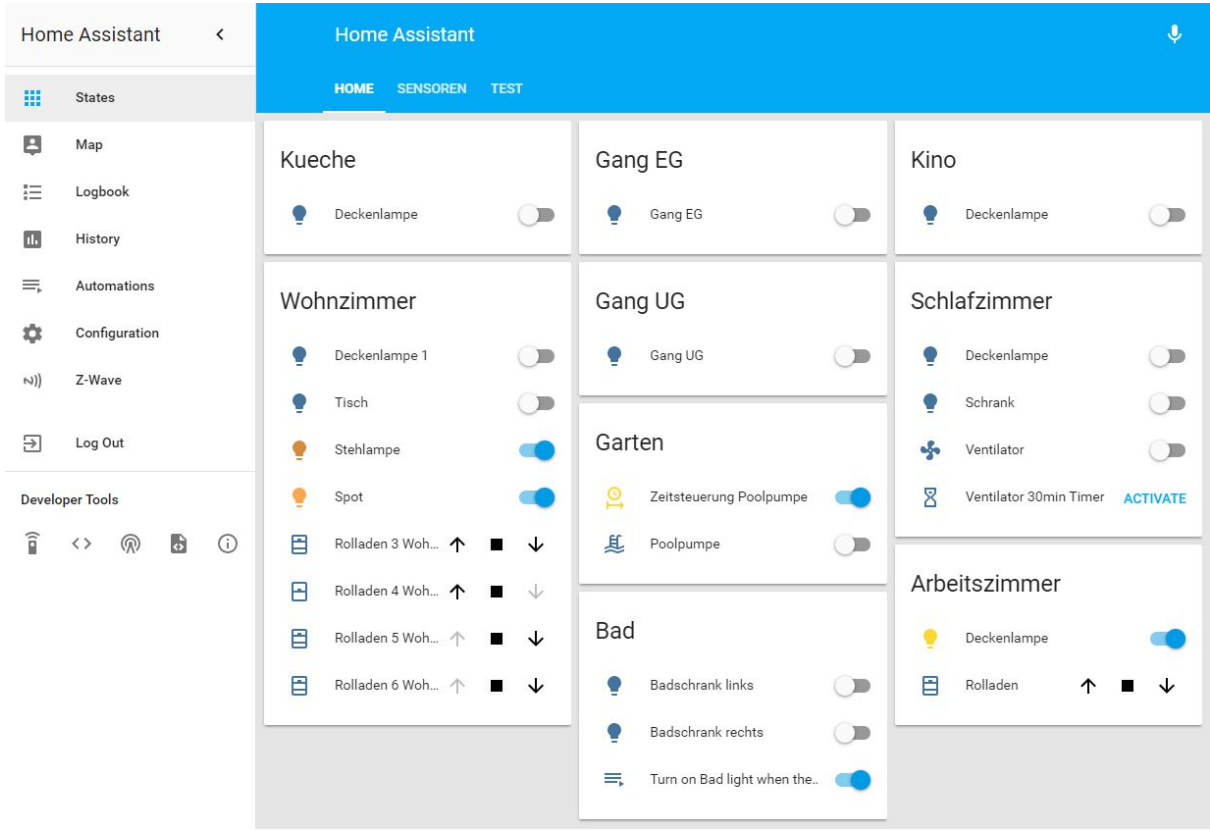
2013

- Home Assistant
- Open-source platform
- Local control, privacy-first
- Extensible with community support



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2014

- Amazon Echo and Alexa
- Voice-controlled
- Control other devices

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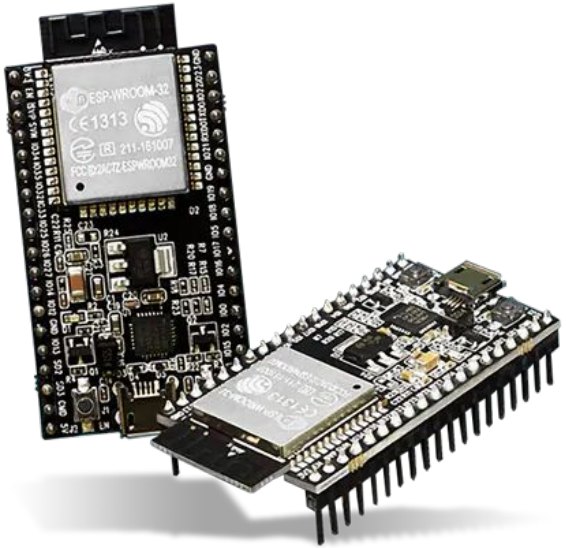
ESPRESSIF

2016

- ESP32
- Wi-fi and BT enabled
- Cheap



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2022

- Matter
- Universal smart home standard
- Wi-Fi, Thread, Ethernet

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What is a
smart home?

?

What is a smart home?

📡 1990s

The internet-connected dumb device

- Smart toaster

📲 2000s

The remote control

- Thermostat, security cameras, smart plugs
- Siri, Google Now

🏠 2010s

The smart ecosystem

- Amazon Alexa, Google Assistant, Apple Home Kit
- Home Assistant, OpenHAB
- Zigbee, Z-wave

🧠 2020s

AI & Context-aware

- ML to predict behavior
- Energy and sustainability
- Local automation over cloud services
- Matter

🔮 Future

?

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What is a smart home?

An adaptive living space where connected devices work together to enhance **convenience, security, and efficiency** to learn from user behavior to anticipate needs rather than just respond to commands.

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SENSORS

Seeing the Invisible

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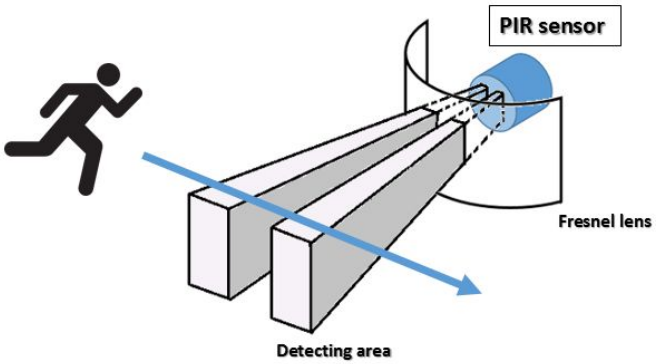
SENSORS

Seeing the Invisible

- PIR - passive infrared



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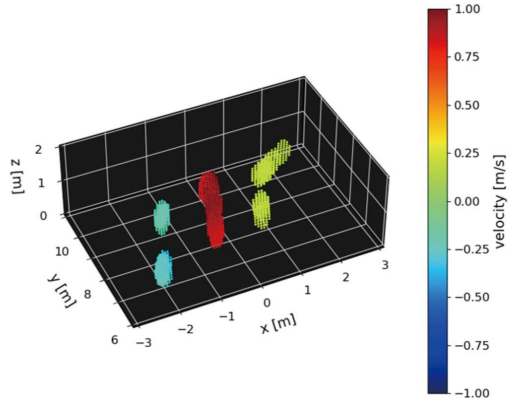
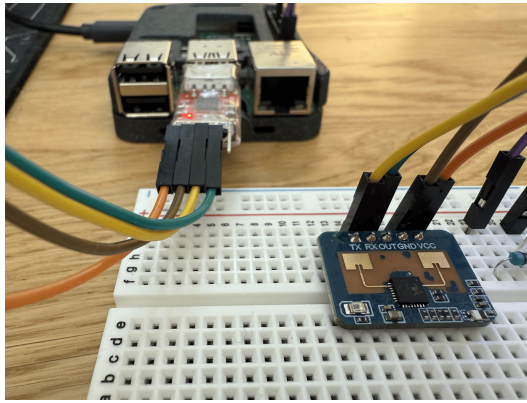
SENSORS

Seeing the Invisible





- PIR - passive infrared
- Mmwave - millimeter wave

LOGS CONNECT

Frame

GetReadings

detection_status	"No Target"
moving_distance_cm	147
moving_energy	0
overall_distance_cm	127
static_distance_cm	147
static_energy	7

kasa-switch generic joyce:kasa:switch

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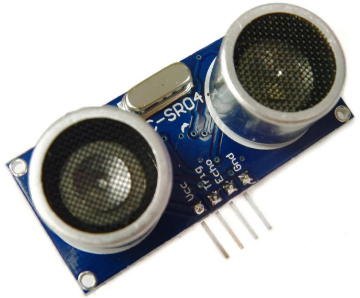
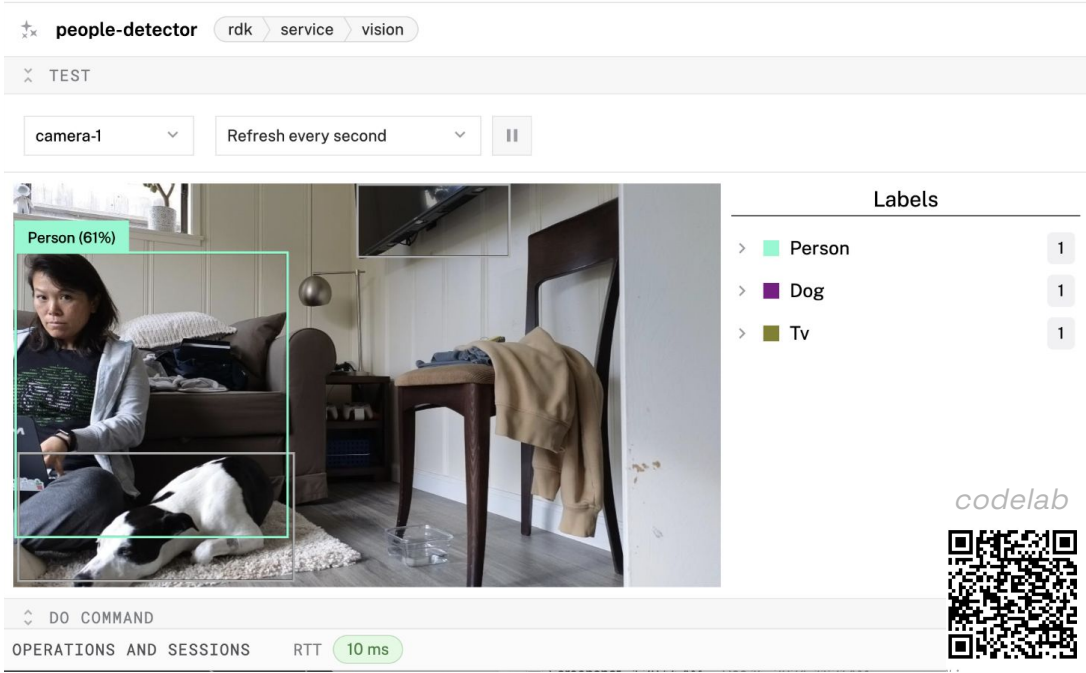
SENSORS

Seeing the Invisible



- PIR - passive infrared
- Mmwave - millimeter wave
- Ultrasonic
- Cameras
- And more!



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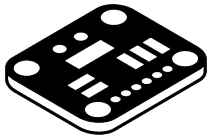
Choosing the right sensors



For your consideration

- Connectivity options

Protocol	Pros	Cons	Best For
Zigbee	Low power, mesh support	Needs a hub, limited range	Smart lights, sensors
WiFi	High bandwidth, no hub	High power, congested frequencies	Cameras, high-data devices
MQTT	Lightweight, reliable messaging	Needs a broker, not for video streams	IoT messaging, sensor networks

- Prioritize Compatibility
- Balance cost vs. accuracy

Advanced mode

- Leverage sensor networks

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ACTUATORS

When your home learns to breathe

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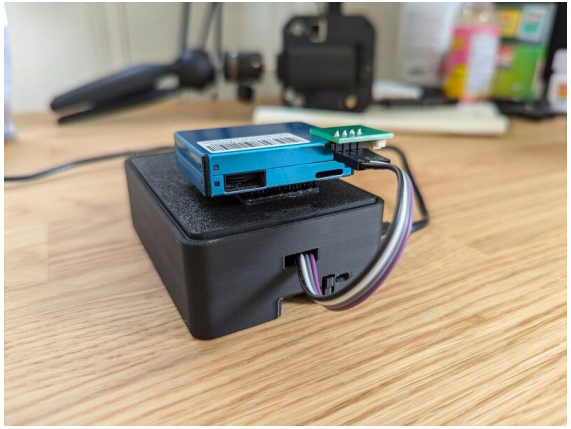
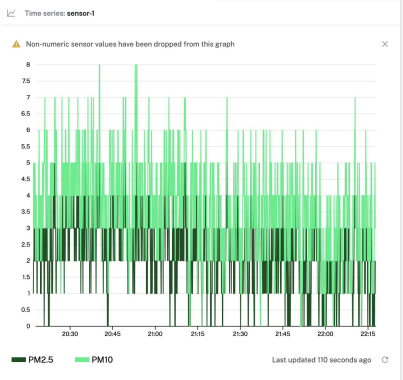
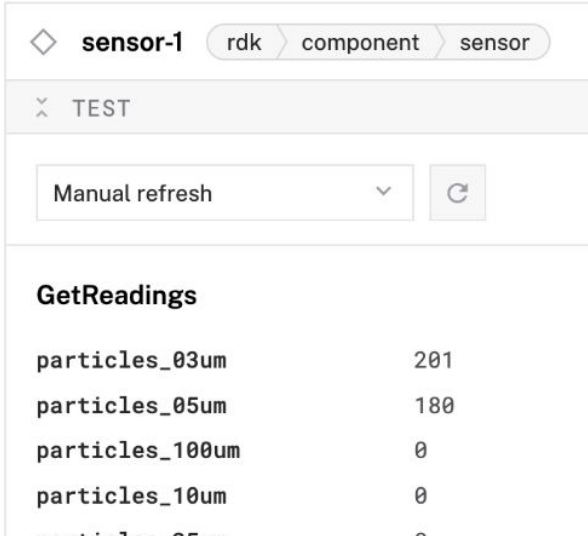
ACTUATORS

When your home learns to breathe



- CO2 - carbon dioxide
- PM2.5 - particulate matter
- VOCs - volatile organic compounds





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ACTUATORS

When your home learns to breathe

- Send an alert
- Activate an air purifier
- Turn on an exhaust fan or HVAC intake
- Open a smart window or ventilation system
- **Baby steps**: smart plug with a box fan

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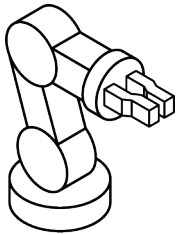
Choosing the right actuators



For your consideration

- Identify the end action
- Consider power requirements
- Balance responsiveness vs reliability
- Prioritize compatibility

Baby steps

- Begin with a smart plug for basic on/off control of a lamp or appliance

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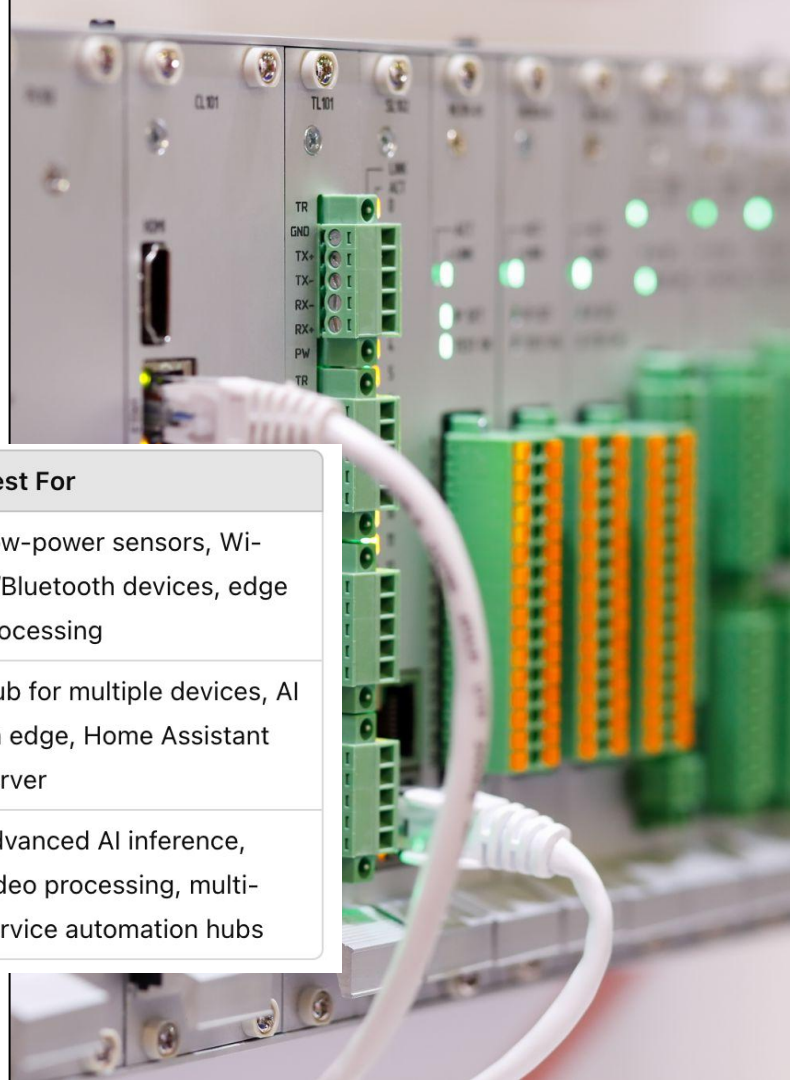
Choosing the right compute behind the automation

Board	Pros	Cons	Best For
ESP32 (Microcontroller)	Energy-efficient, built-in Wi-Fi/Bluetooth, real-time applications	Limited RAM/storage, requires more programming	Low-power sensors, Wi-Fi/Bluetooth devices, edge processing
Raspberry Pi (SBC)	Versatile, strong community support, broad OS support	Power-hungry, SD card reliability issues	Hub for multiple devices, AI on edge, Home Assistant server
Beelink (Mini PC)	High performance, supports Windows/Linux, multiple OS options	Expensive, higher power consumption	Advanced AI inference, video processing, multi-service automation hubs



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Choosing the right compute behind the automation

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ESP32-S3

Pi AI HAT+

Coral TPU

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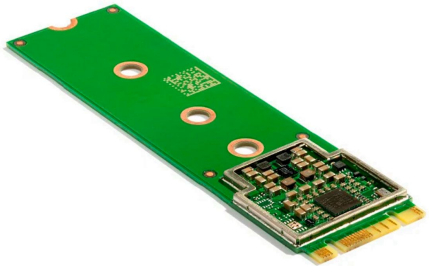
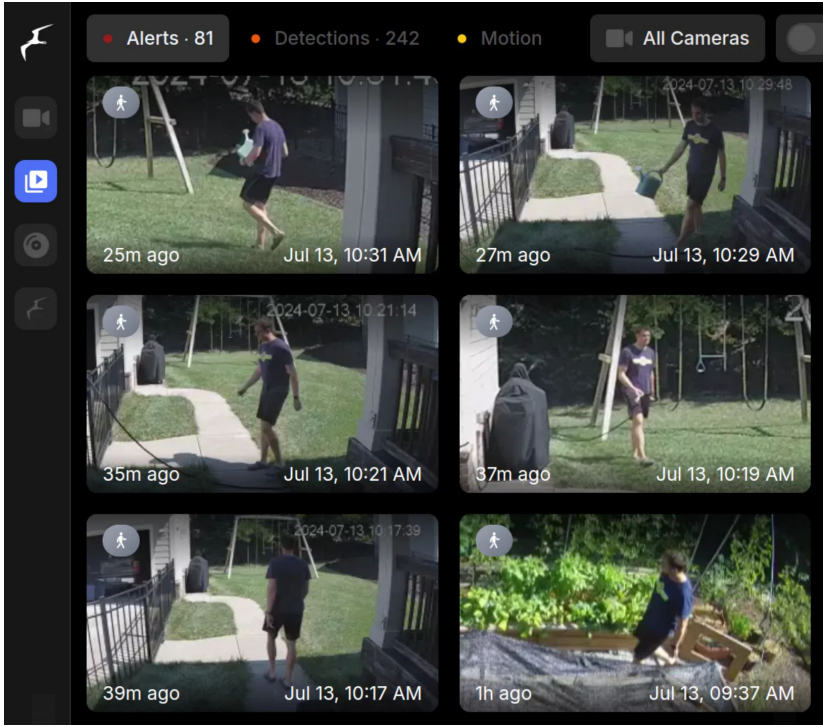
DECISIONS

Choosing the right AI

- Frigate - Network video recorder (NVR)



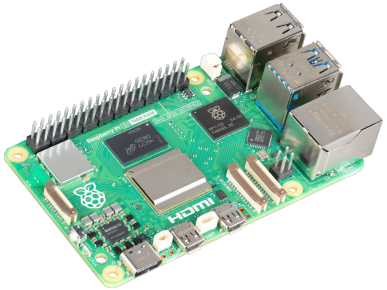


DECISIONS

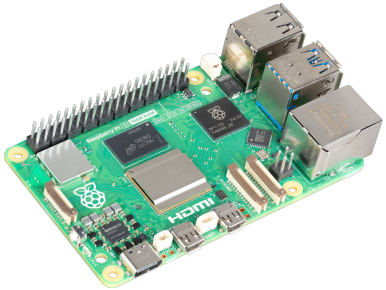
Choosing the right AI

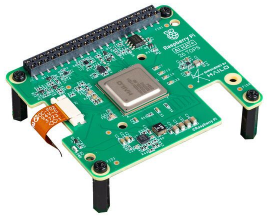
- Viam integration with Home Assistant

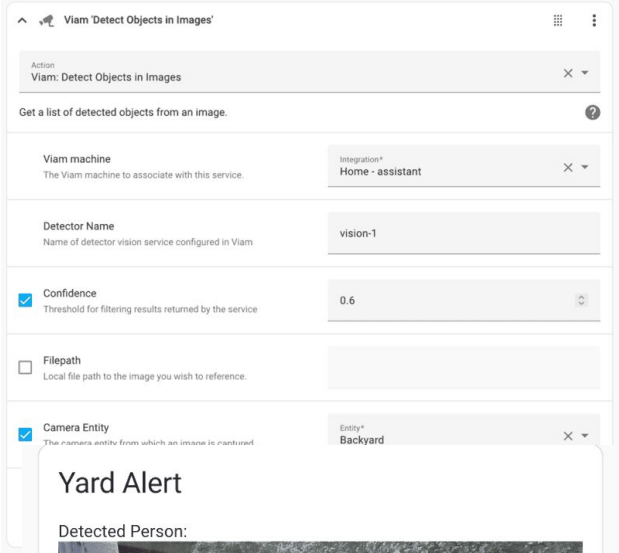
Home Assistant

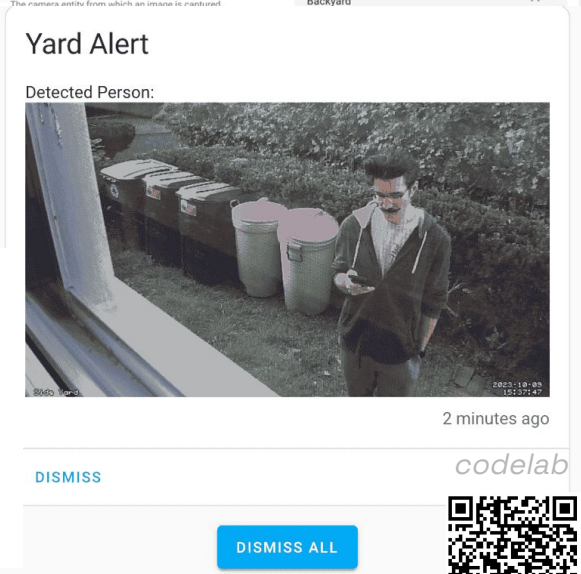


TFLite, COCO









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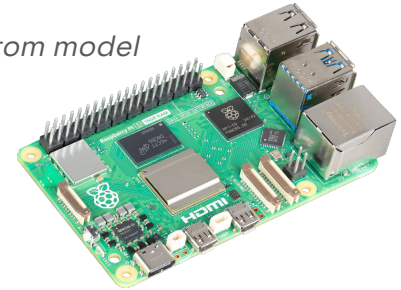
DECISIONS

Choosing the right AI

- Refill snack dispenser

custom model



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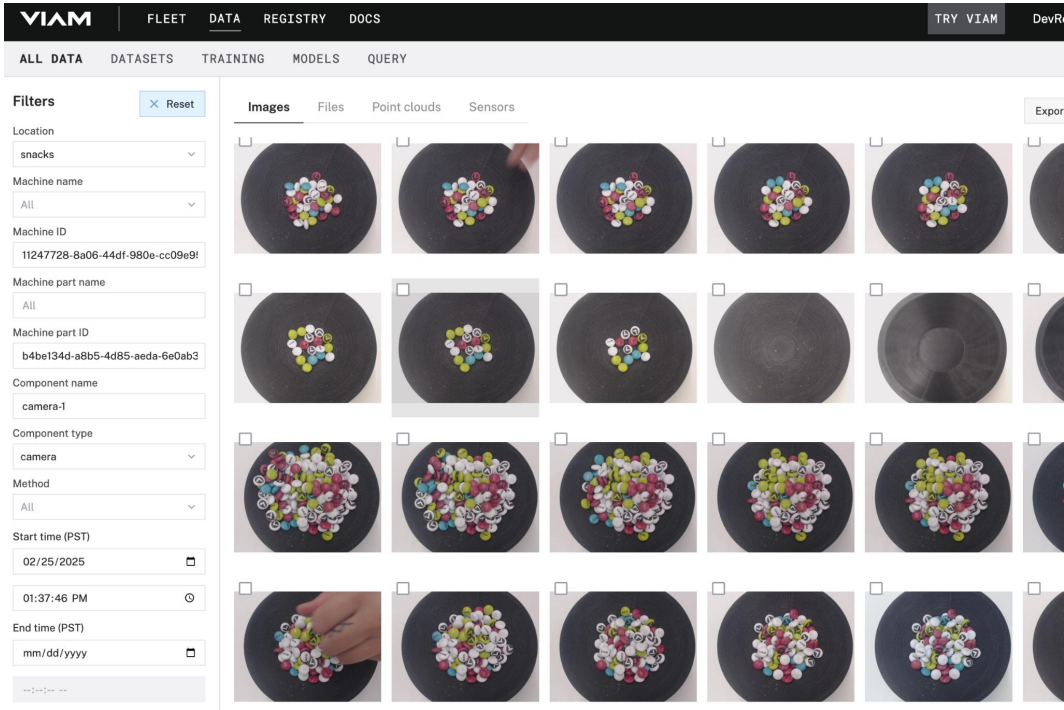

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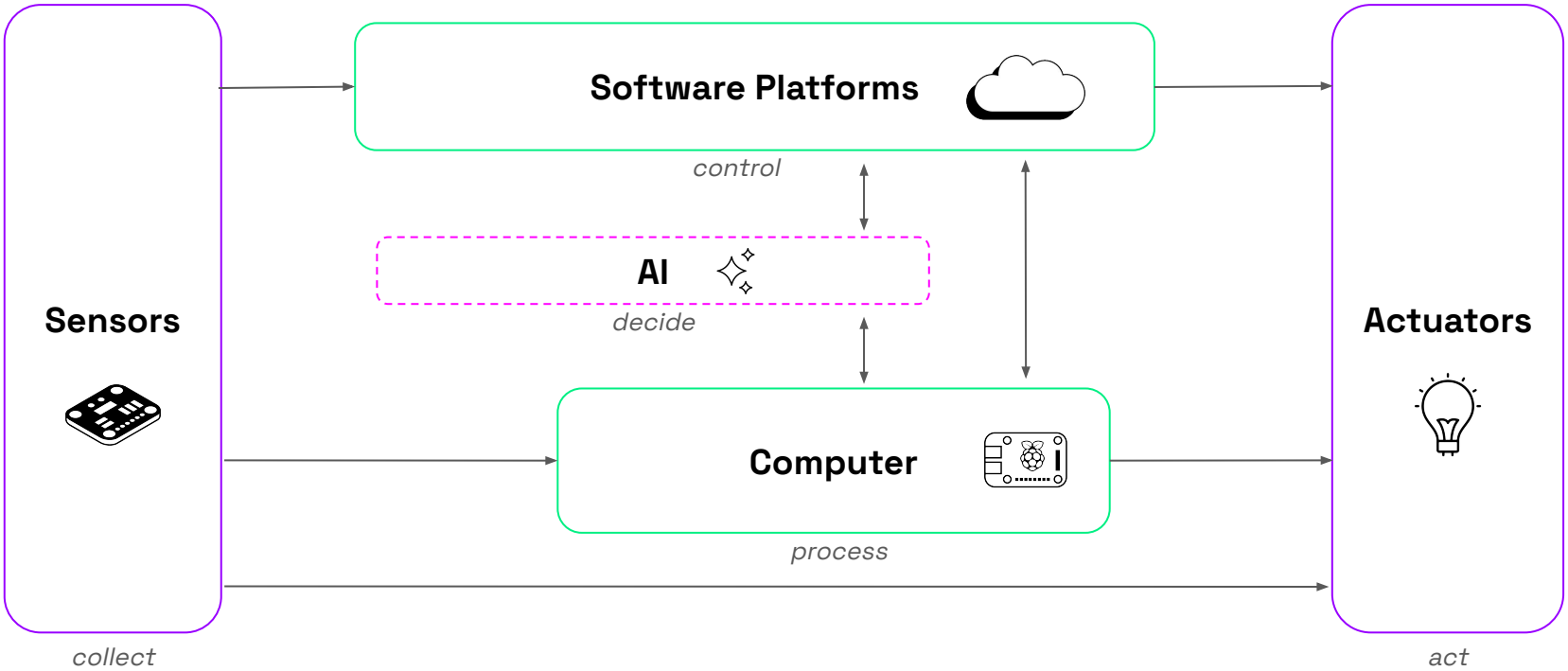
HOME AUTOMATION



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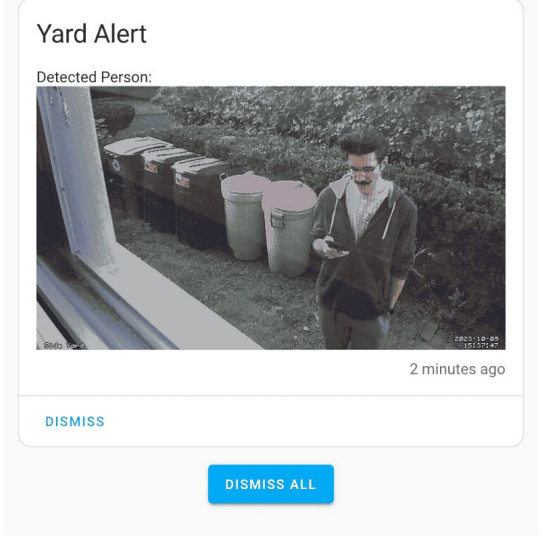
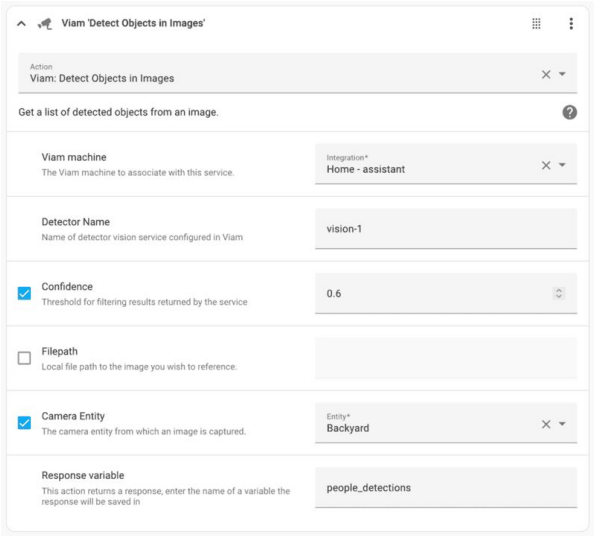
AUTOMATIONS

Context-aware automations

- Instead of a notification that someone is in your yard, raise a barrier to permit access or sound an alarm to scare them away





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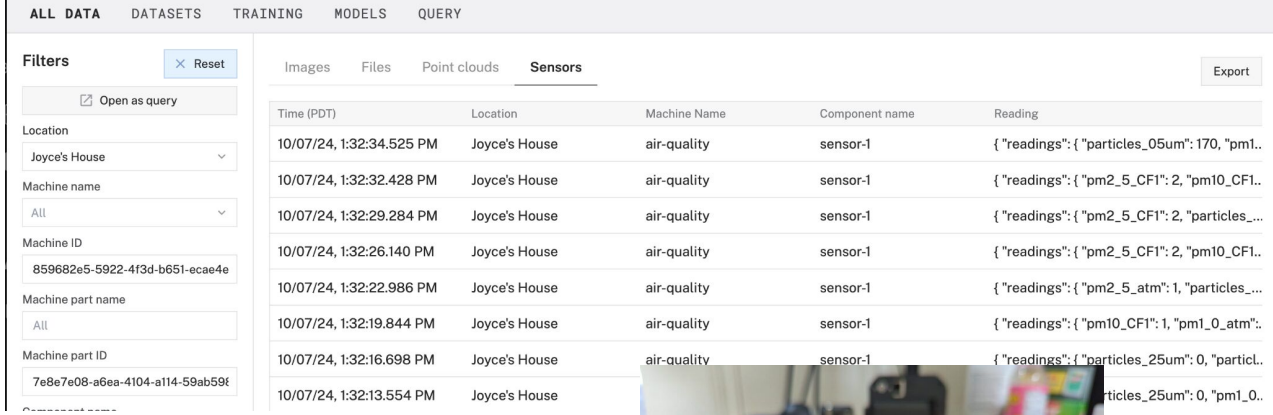
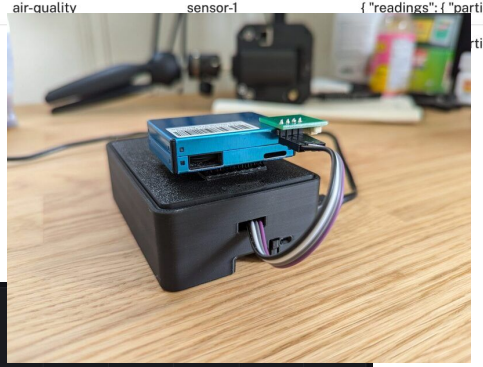
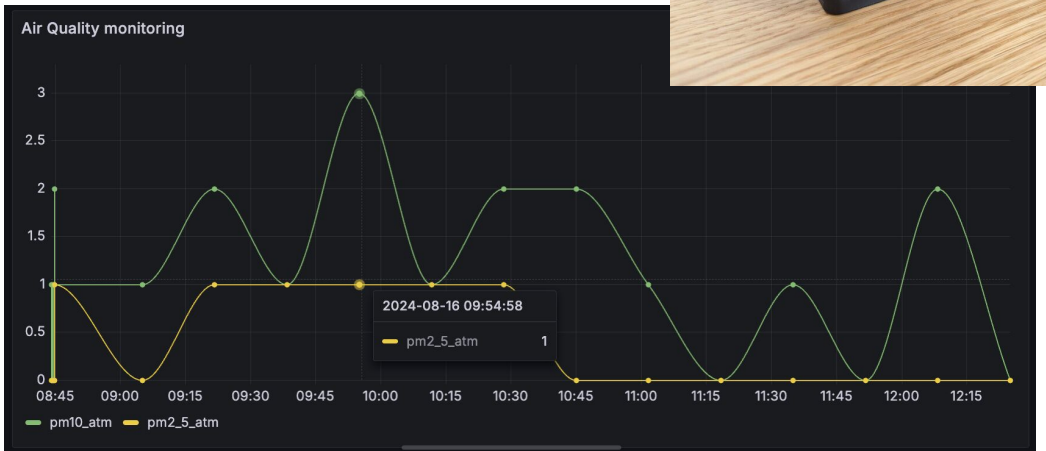
AUTOMATIONS

Context-aware automations

- Instead of logging spikes in air quality, trigger an air purification system or identify root cause of fluctuations







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AUTOMATIONS

Context-aware automations

- Instead of an alert when a leak is detected, a smart home shuts off the water valve automatically.

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CONTEXT-AWARE AUTOMATIONS

Thinking beyond just “on” and “off”

- Leverage sensor networks
- Someone in the room?
    - Presence
    - Person vs cat
    - Time of day
    - Low light
    - Temperature

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CONTEXT-AWARE AUTOMATIONS

Thinking beyond just “on” and “off”

- Choosing actuators that adapt (respond proportionally)
- Someone is in the room
    - Turn on the light based on ambient light
    - Update the thermostat according to personal preferences
    - Trigger air filtration based on occupancy

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📡 1990s

The internet-connected dumb device

- Smart toaster

📲 2000s

The remote control

- Thermostat, security cameras, smart plugs
- Siri, Google Now

🏠 2010s

The smart ecosystem

- Amazon Alexa, Google Assistant, Apple Home Kit
- Home Assistant, OpenHAB
- Zigbee, Z-wave

🧠 2020s

AI & Context-aware

- ML to predict behavior
- Energy and sustainability
- Local automation over cloud services
- Matter

🔮 Future

Adaptive & Intent-based

- AI models to anticipate needs
- Edge computing
- Ecosystem compatibility

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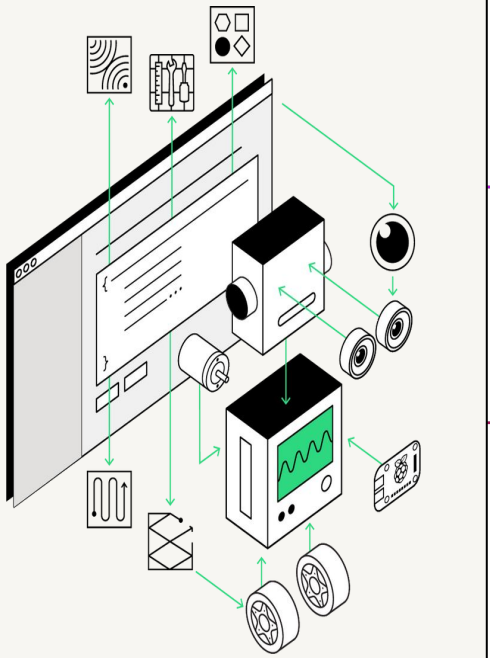

How to not rely on cloud services

Privacy, speed, reliability

- Use open-source software and models
- Train in the cloud, deploy locally
- Adopt local protocols

The smartest home is one that you control

Cost, control, privacy, resilience

- Leverage sensor networks
- Choose interoperability
- Know when to self-host
- Know how to prompt AI

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Thank You!

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Presence detector

Air quality monitor

People detection in Home Assistant

Snack dispenser

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