

LUXonjs

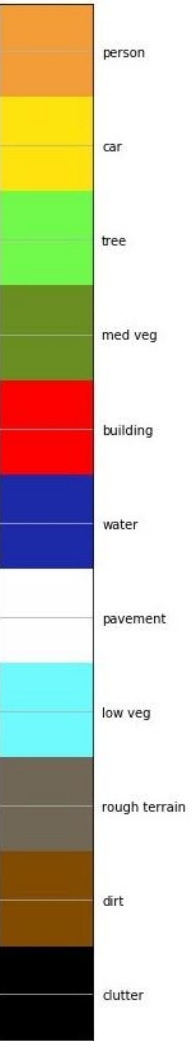
EMBEDDED CV + AI

Start With the Why

- The Fourth Industrial Revolution will be driven by Embedded AI
- Computer Vision has already surpassed human capability on the cloud
- Soon to be surpassed in embedded

Inflection Point

- Capability to sense and derive meaning/value from video
- On-platform
- Real-time
- Embedded



Video as a Sensor

- Video is no longer for the sake of video
- The AI interprets the video
- Producing alerting, business insights, and situational awareness
- In-situ action can be taken



Active Alerts

Worker in dangerous area detected not wearing helmet

12 minutes ago.

Battery tank #3 hatch left open after worker departed.

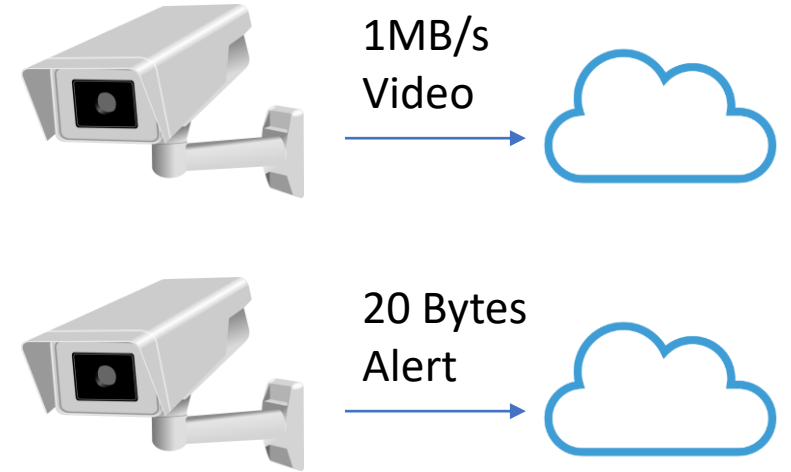
37 minutes ago.

Battery tank #3 hatch left open after worker departed.

7 hours ago.

New Concepts of Operation

- Before now, such AI had to be in the cloud
- On device, a lot changes:
 - Latency (and reliability/predictability)
 - 2-3 orders of magnitude (e.g. 1ms from 1s)
 - Privacy
 - Image/Video never has to be sent or even stored
 - Bandwidth
 - 5 orders of magnitude (1 million Bytes per second to 20 Bytes per notification)
 - Remote Connectivity
 - Ultra-low-data-rate connectivity like LoRaWAN now possible
 - Sensor and Actuator Integration



Example Use-Cases

- Autonomous inspection
- Human-aware equipment
- Operational awareness
- Non-intrusive sensing
- Anomaly detection



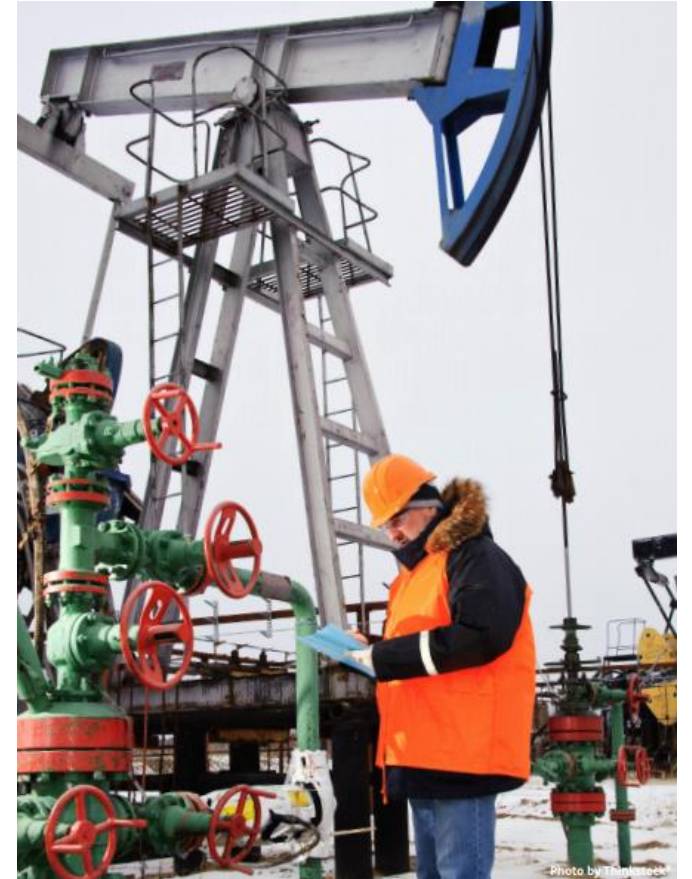
Autonomous Inspection & Alerting

- Dynamically mapped and labeled
 - Problem areas spotted in-flight
 - More detail automatically recorded in problem areas
- Increases detection probability
- Provides significantly more data on problem areas
- Reduces need to re-fly to re-inspect problem areas



Human-Aware Equipment

- On-Device AI allows machines to know where people are, and what they're doing.
- Same system can integrate machine-state.
- Enables real-time warning if a person is about to:
 - Enter an unsafe area given equipment state
 - Perform an action which is dangerous given equipment state
 - Perform an action that may damage or destroy equipment



Operational Awareness

- Which trucks visited, when
- Logs and Alerting based on
 - Duration
 - License Plates
 - USDOT
 - Procedural
 - Speed
 - Cones
 - Chalked wheels
 - Ground straps, etc.



Site: TBBelS147

USDOT: 1499260

License: Iowa SG-7259

Arrived: 3/6/19 13:23:47

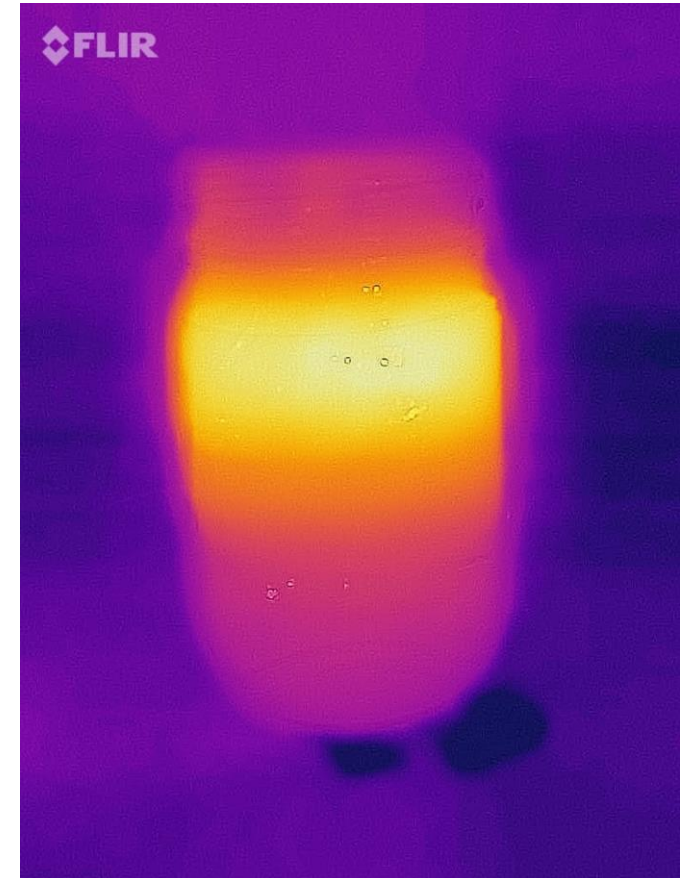
Departed: 3/6/19 14:04:19

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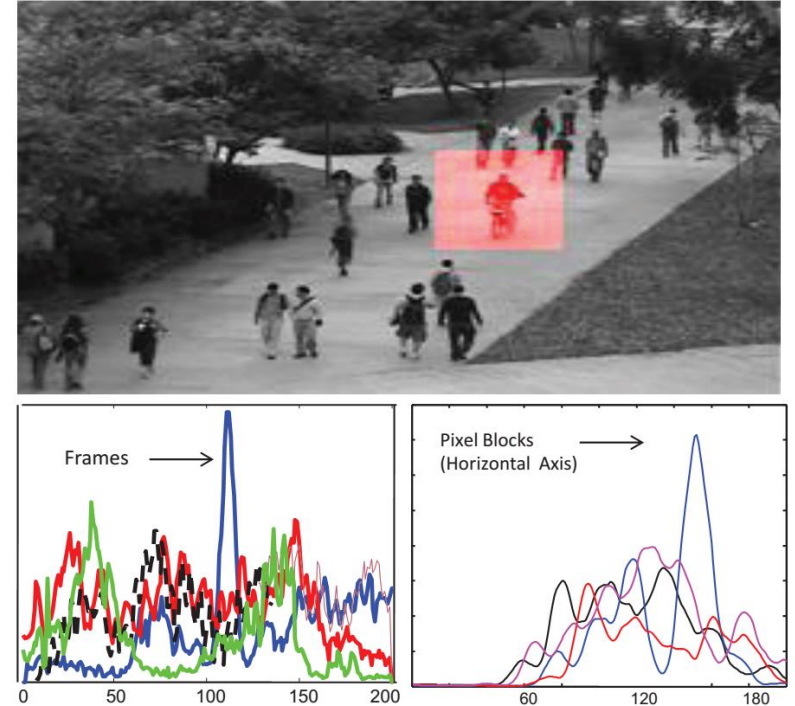
Passive Sensing

- Passively add tank constituent monitoring and reporting
- AI trained on ground truth of what tank constituents look like through multispectral
 - Able to reproduce sensing that would otherwise require intrusive measurements
- Enables liquid-leak detection



Anomaly Detection

- Non-specific-case problem detection alerting
- Unlike algorithmic, trained models can learn a sense or normal/nominal and alert accordingly
- Accuracy and fidelity improves over deployment and use
- Multi-sensor fusion on-site



Summary

- AI's biggest wins are in perception
 - Image/Video is ~80% of the AI communities efforts
 - Time-series rounds out the rest
- A result is video no longer has to be for the sake of video
 - Allows real-time situational awareness
 - Monitoring and alerting in ways previously impossible
 - Low-bandwidth remote application now possible
 - Fusion with other sensors and machine states
- Cameras can now be deployed in ways that respect privacy
 - The image/video data is not stored or transmitted

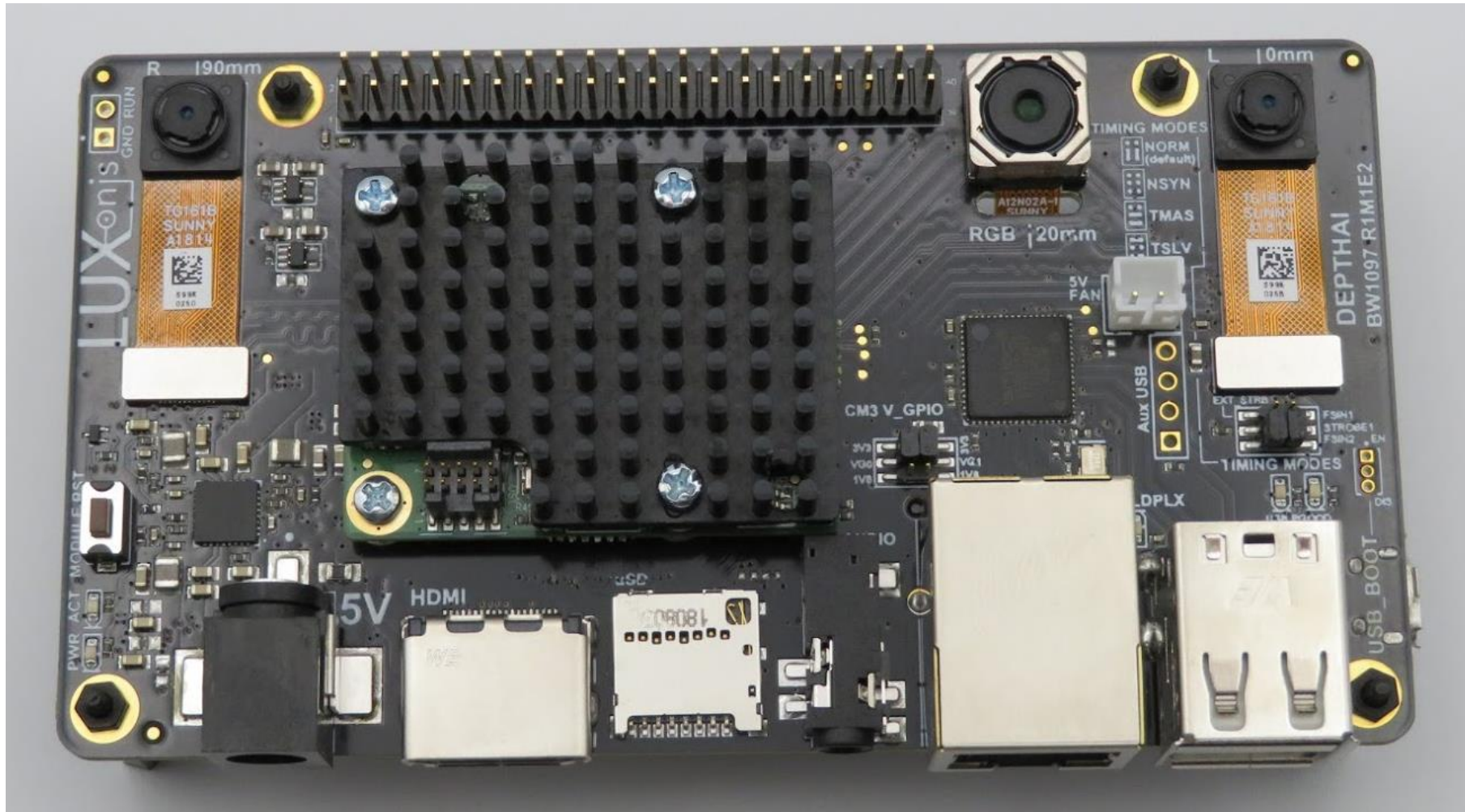
Questions

- What are your hardest problems currently?
- What did I not cover that you'd like to know about artificial intelligence, computer vision, or embedded systems?
- Are you deploying AI in your HSE systems or solutions now?

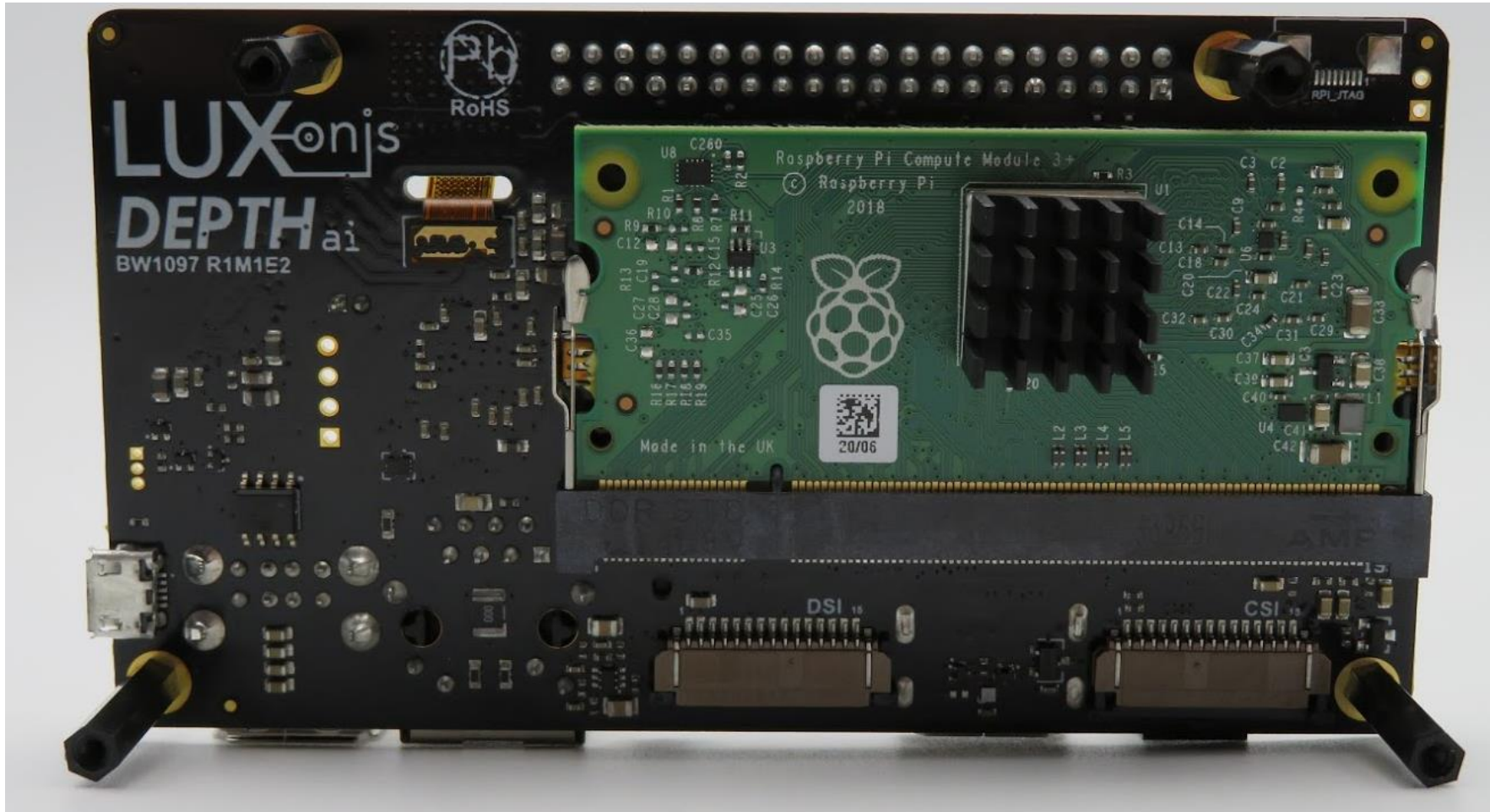
Supplementary Material

- Aerial Semantic Segmentation:
<https://www.youtube.com/watch?v=1EB5bpmUq1Q>

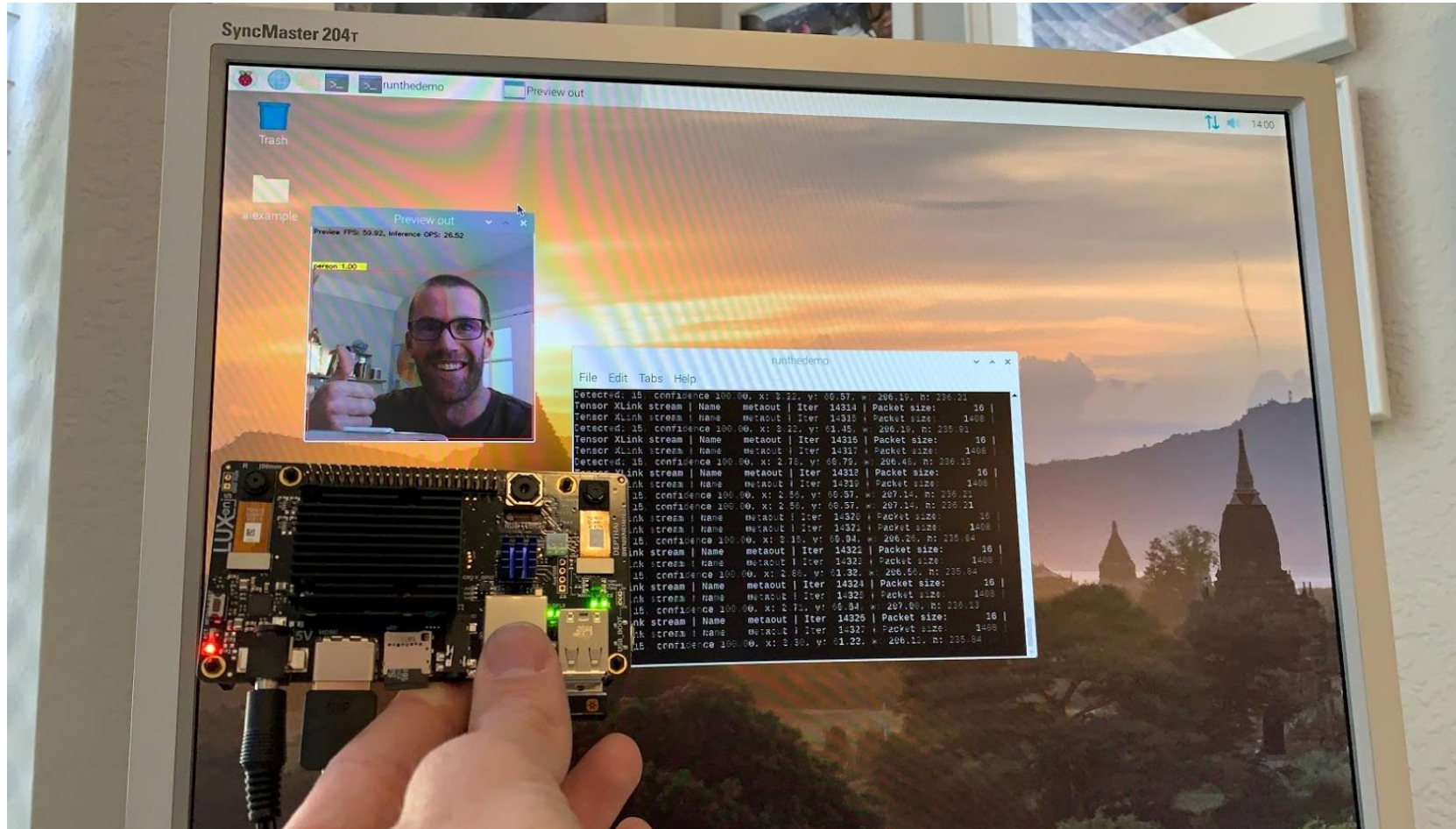
DepthAI Platform for Raspberry Pi



DepthAI Platform for Raspberry Pi



DepthAI Platform – Person Recognition



DepthAI – Multi Remote Sensors

