tinyML® EMEA

Enabling Ultra-low Power Machine Learning at the Edge

tinyML EMEA Technical Forum 2021 Proceedings

June 7 – 10, 2021

Virtual Event

www.tinyML.org

emza
visual sense

TinyML Journey - contextual awareness for laptop PCs

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TINY ML

About emza

- Founded in 2006 in Israel, with a vision for low power edge computing
- Develops & sells ultra-low power computer vision solutions(HW & SW)
- Acquired by Himax Technologies in 2018. (NASDAQ:HIMX)

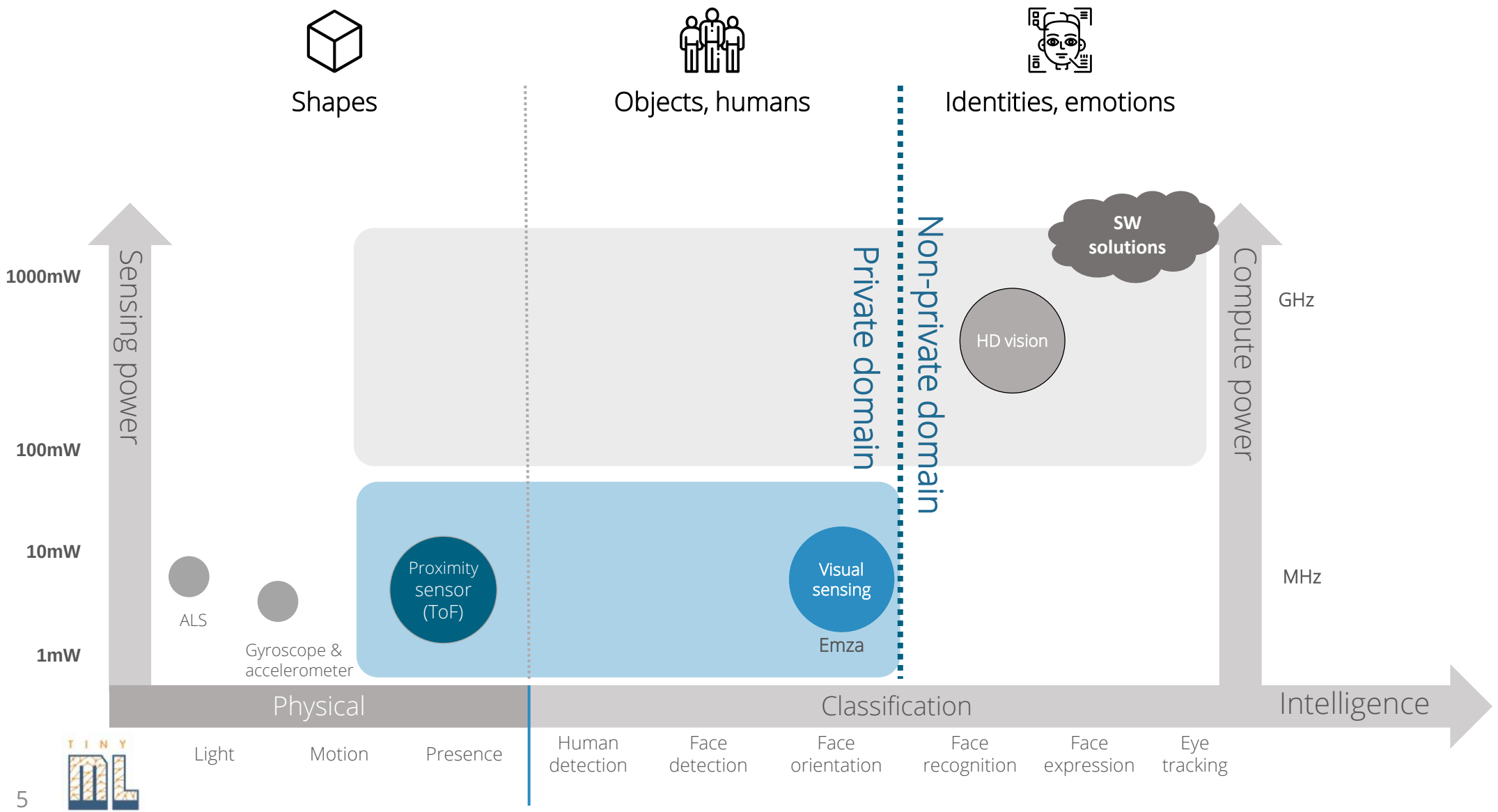
The starting point

CES 2019, Intel announced project Athena

Opportunity:

provide contextual understanding in privacy, at low power based on Ai

AI landscape with visual sensing



Human Presence Detection (HPD)

Use cases

Wake on approach

Automatic wake up

Touchless Hello/Login experience

User presence

Classification – humans vs objects

Walk away lock

Automatic screen lock – security

Automatic screen off – power save

CES 2020 demo: Wake on Approach

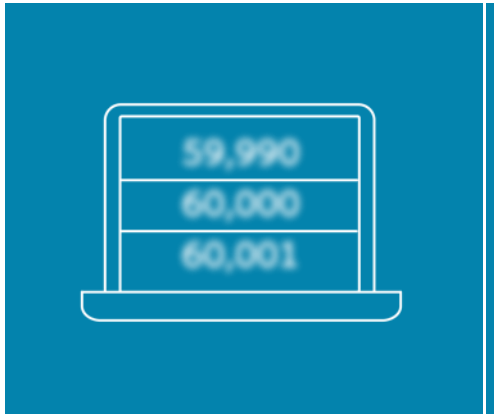
Contextual privacy

Understanding the context and actively improve privacy security

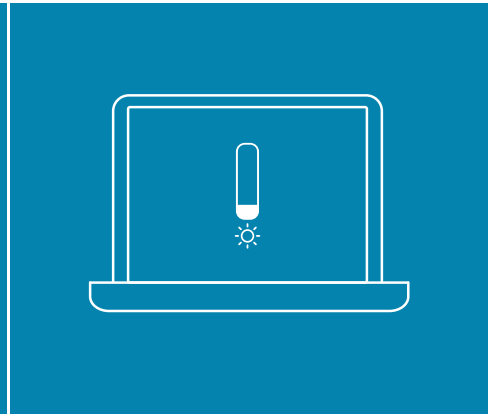
Sensing

Intruder alert

System response



Auto screen blur



Auto screen dim

User engagement detection at low power

Opportunity to extend battery life by 20%

- New concept: user engagement status
- Engaged: frontal face detected
- Not engaged: user is not looking on the display

New classification requirements:

- Yaw angle
- Head classifier

extends battery life with Adaptive dimming

Engaged

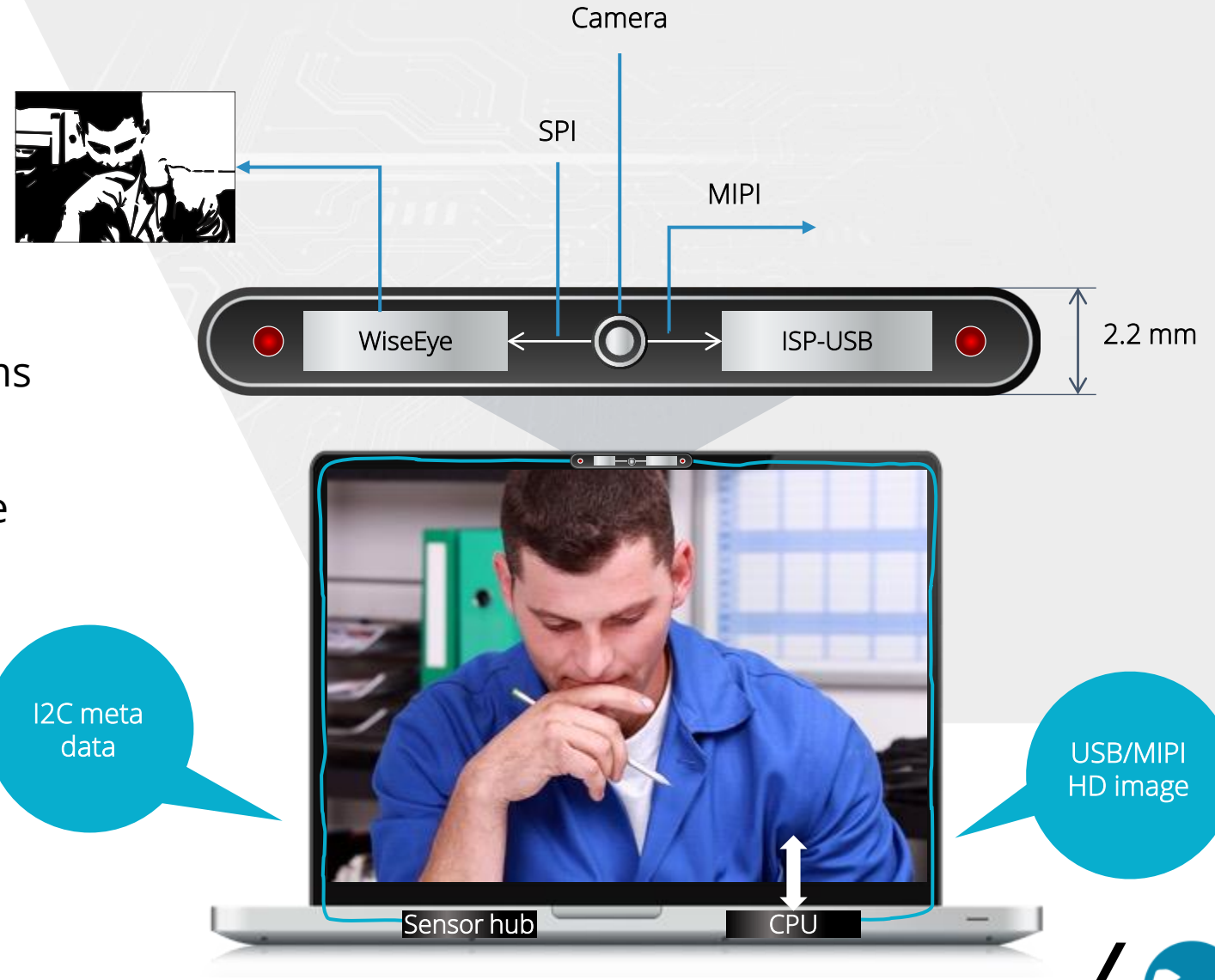
– high illumination

Not Engaged

– dimming

Visual sensing in PC – system architecture

- Human presence detection algorithms
- WiseEye1 ULP CV ASIC
- Integrated within the camera module
- Always-on sensing
- User privacy guaranteed



Real World Challenges

- The Distance / Field of view / execution speed tradeoff
- Faces in the wild
- How can one detect the engagement level?
- Hard illumination condition as the typical environment

Distance / Field of view / speed challenge

Requirements:

Distance: 25-200cm

Horizontal field of view: 70°

Processing: 8-10 FPS

Output: bounding boxes

Moving to Detector

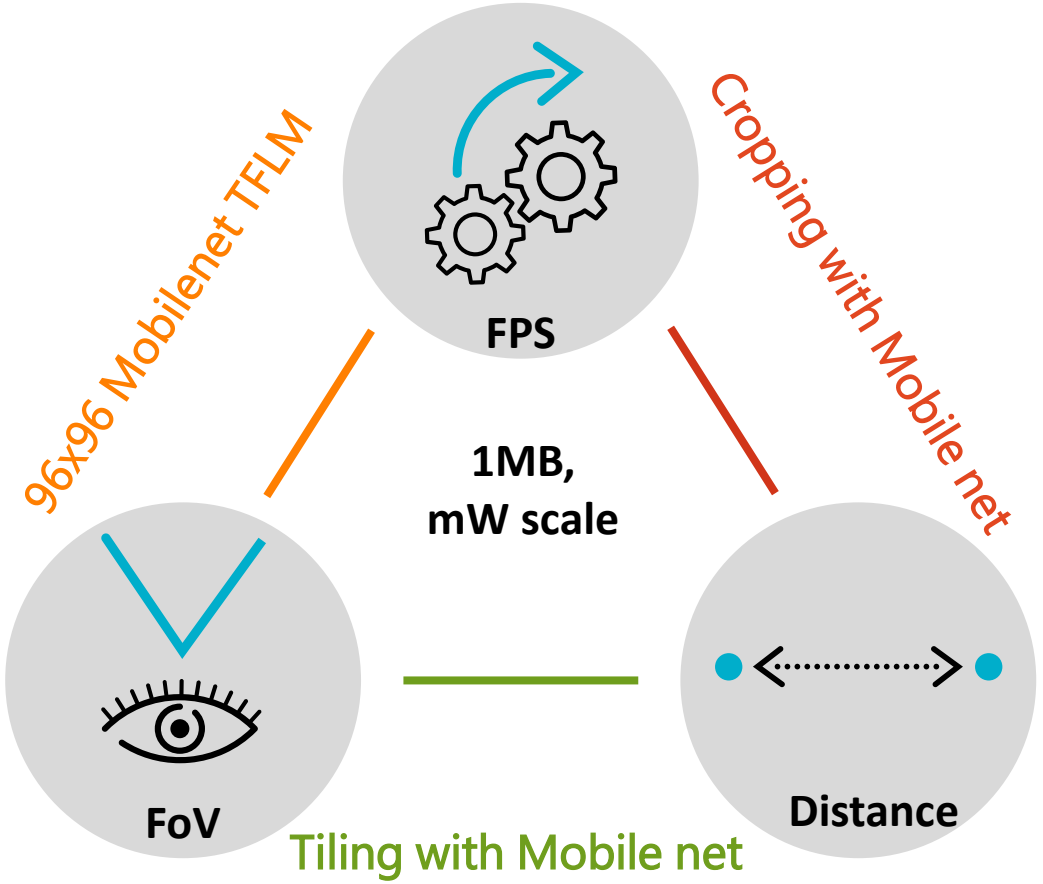
Motivation for detector

- Bounding box (object location)
- User distance estimation (based on face size)
- Tracking (save power)
- Advanced classification options

But,

running SSD on microcontroller in a naïve manner is merely impossible…

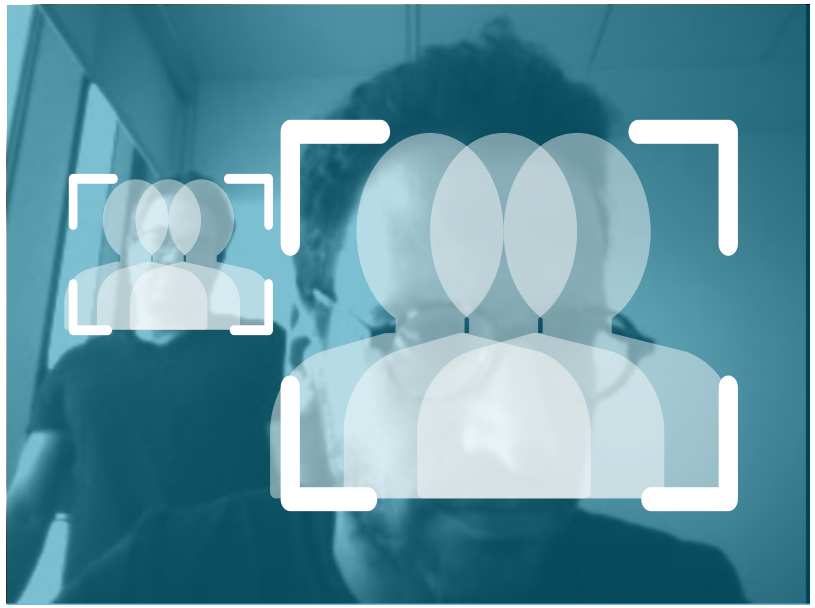
Distance / Field of view / FPS challenge



“micro” CV detector pipeline

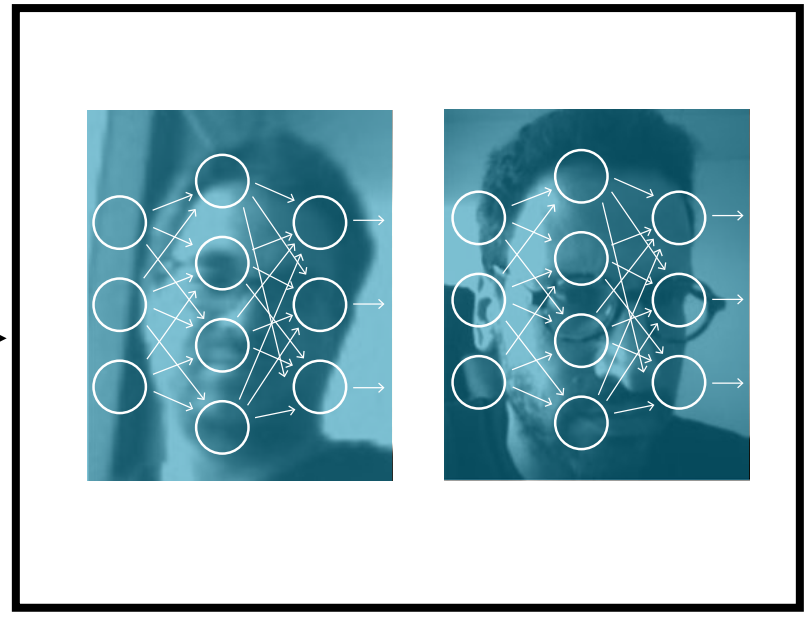
- Classical ML for fast box proposal
- Deep learning for short distance / within the boxes

Stage 1: Detection



Fast face detector with Classical ML

Stage 2: Classification

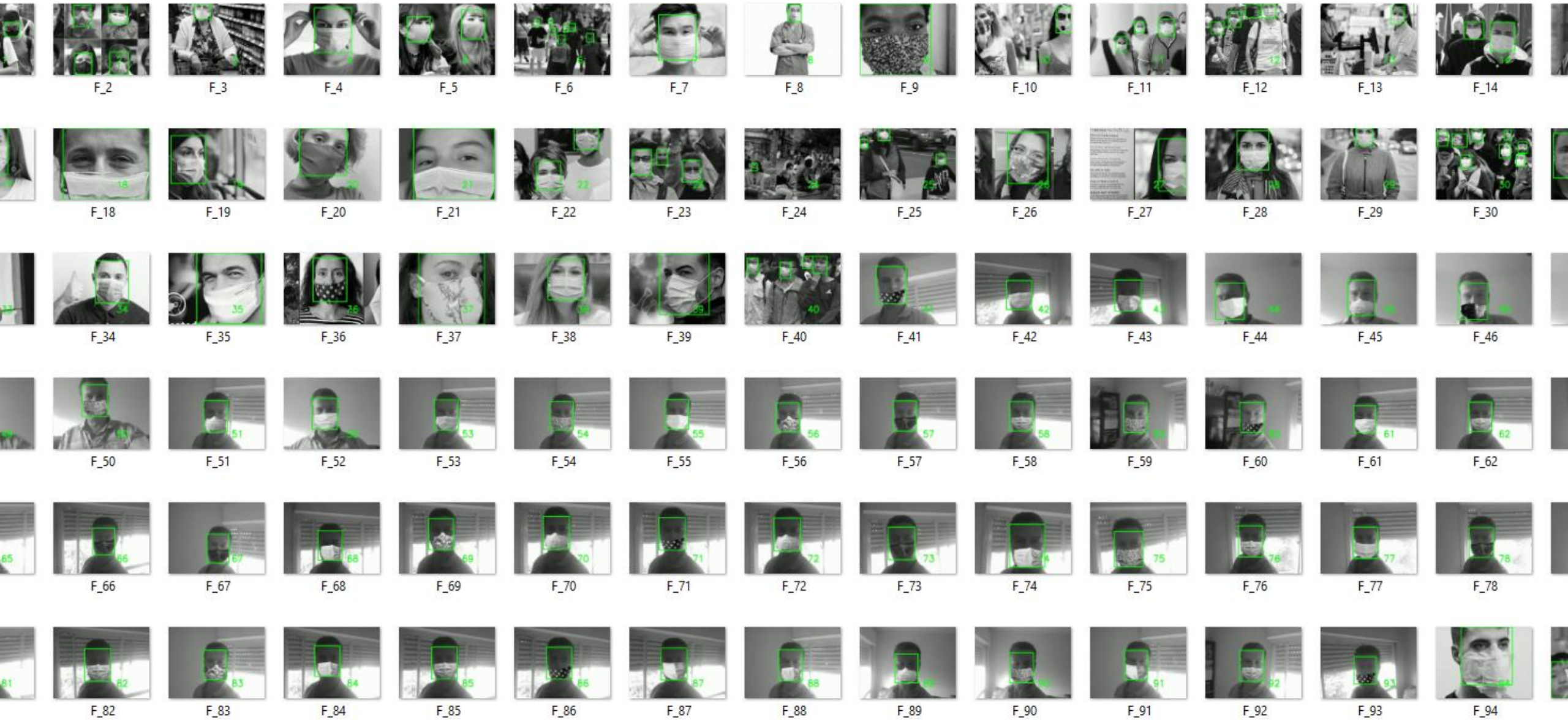


Advanced classifiers within the proposed boxes

Putting it all together

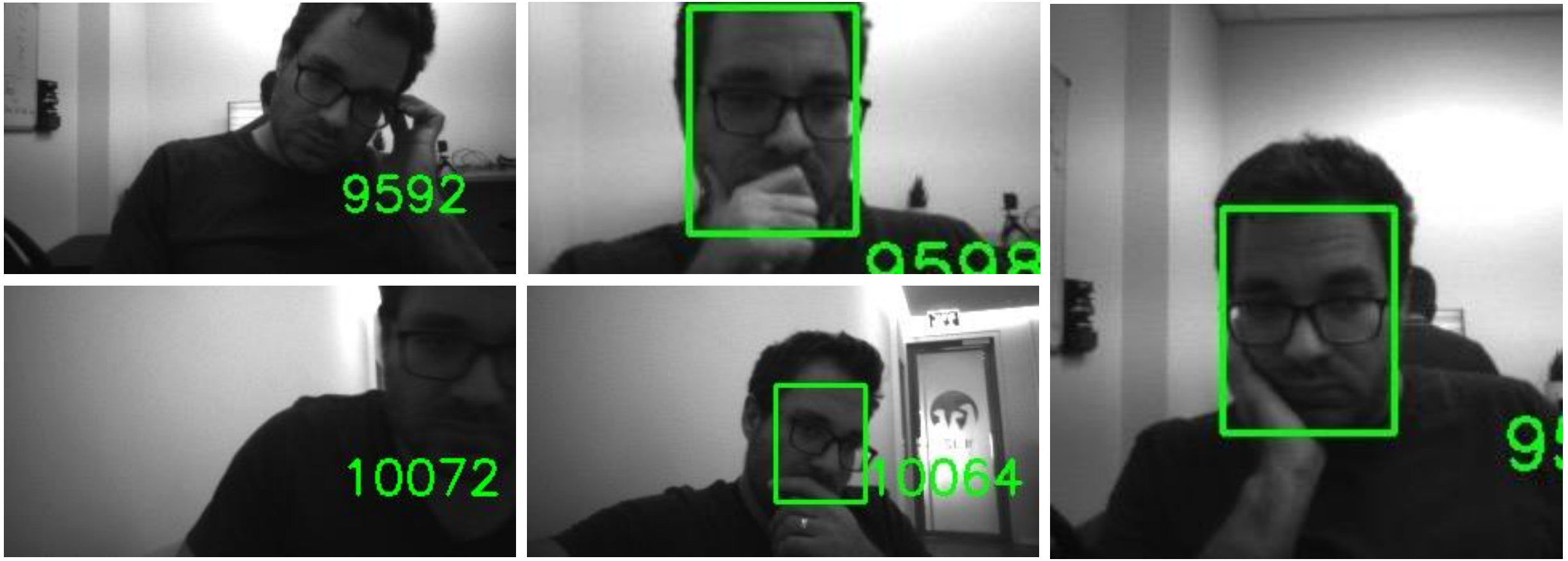
Face detection & yaw angle estimation video

And then Covid-19...



Real world variety

Natural user posing

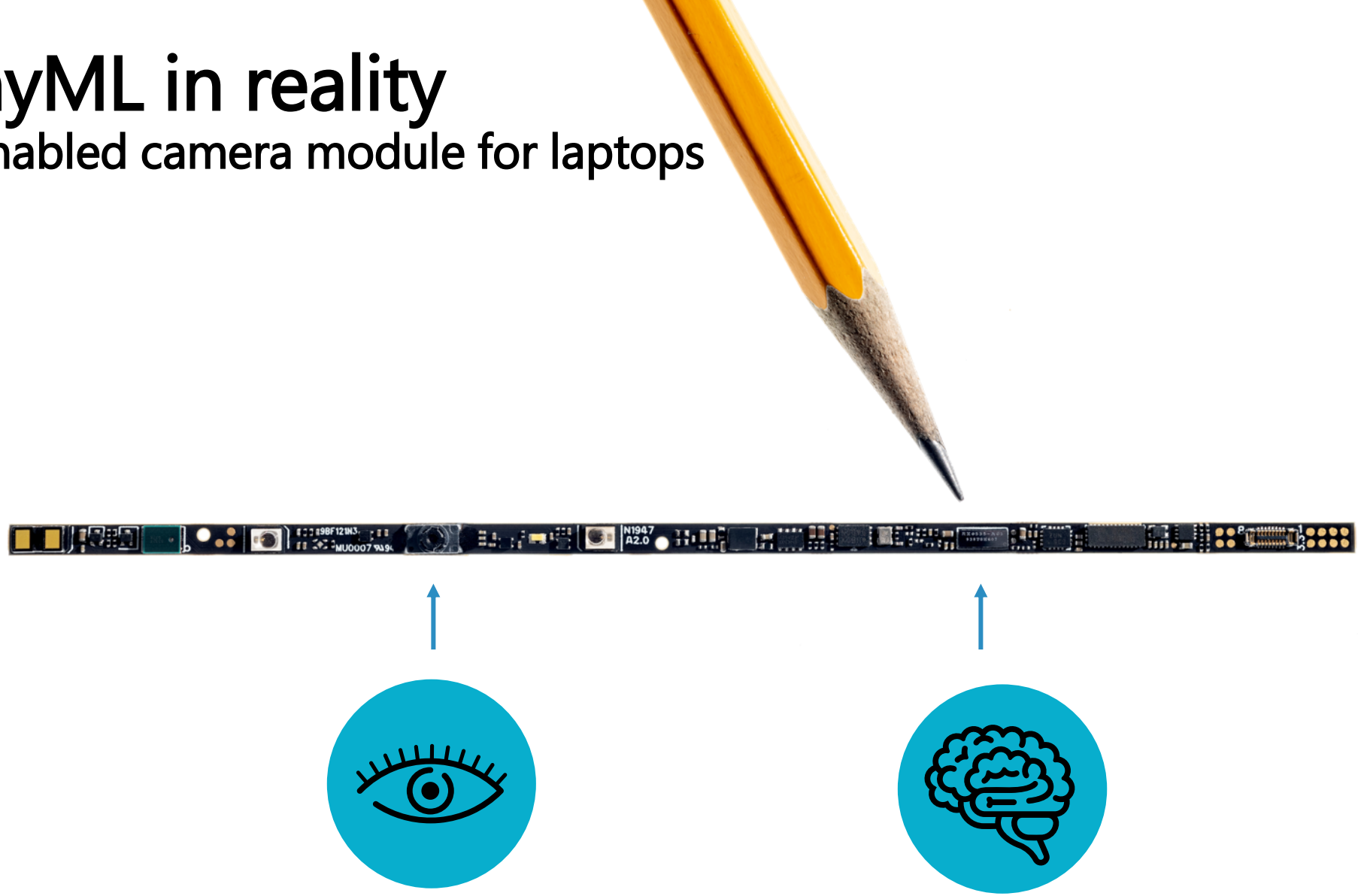


Real world variety

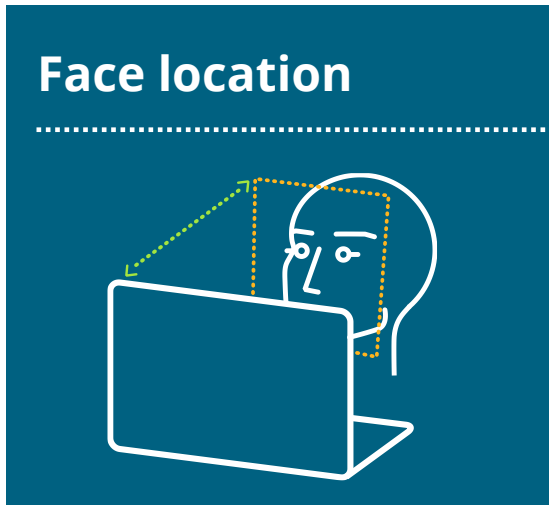
It is not all about Lux, it's the dynamic range

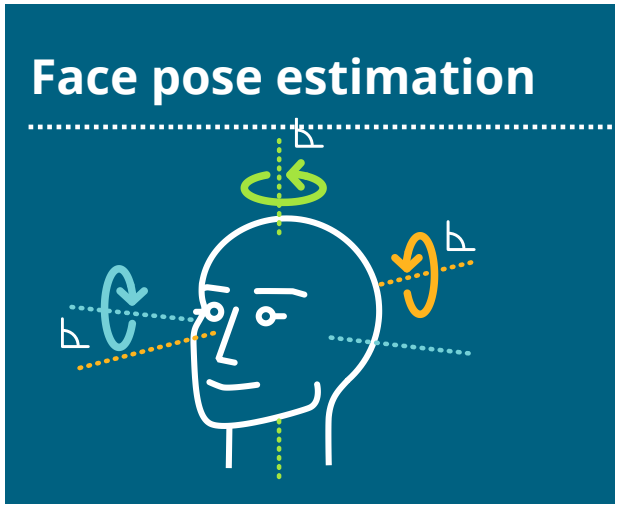
TinyML in reality

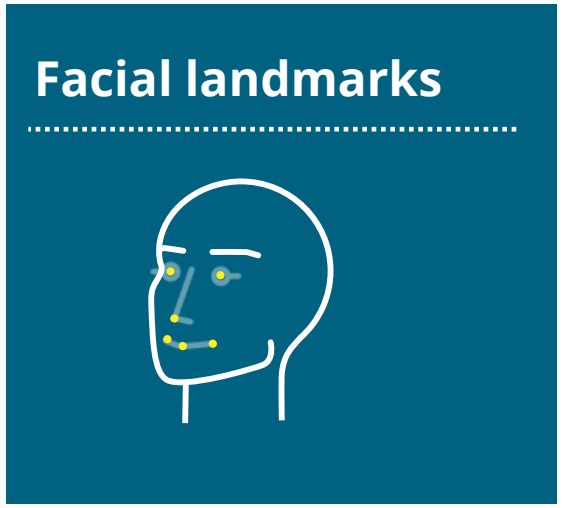
Ai enabled camera module for laptops

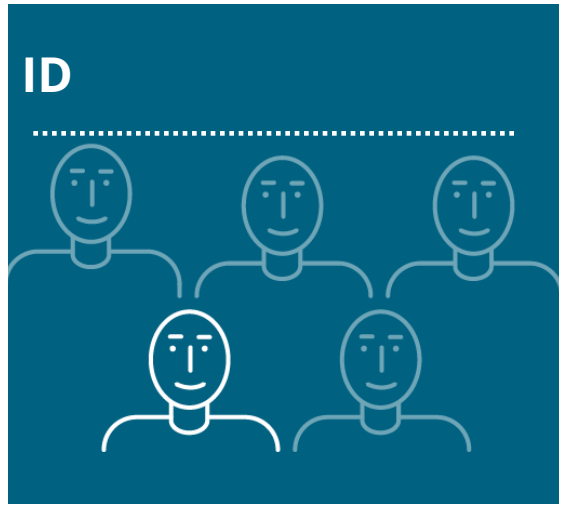


The journey has just begun









- TinyML brings value to consumers applications
- Demo is easy
- Getting to deployment level requires a lot of data science and optimization work
- We are in the early days of adoption
- Innovation in algorithms & silicon IP will enable more sophisticated use cases and will accelerate adoption

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Thank you

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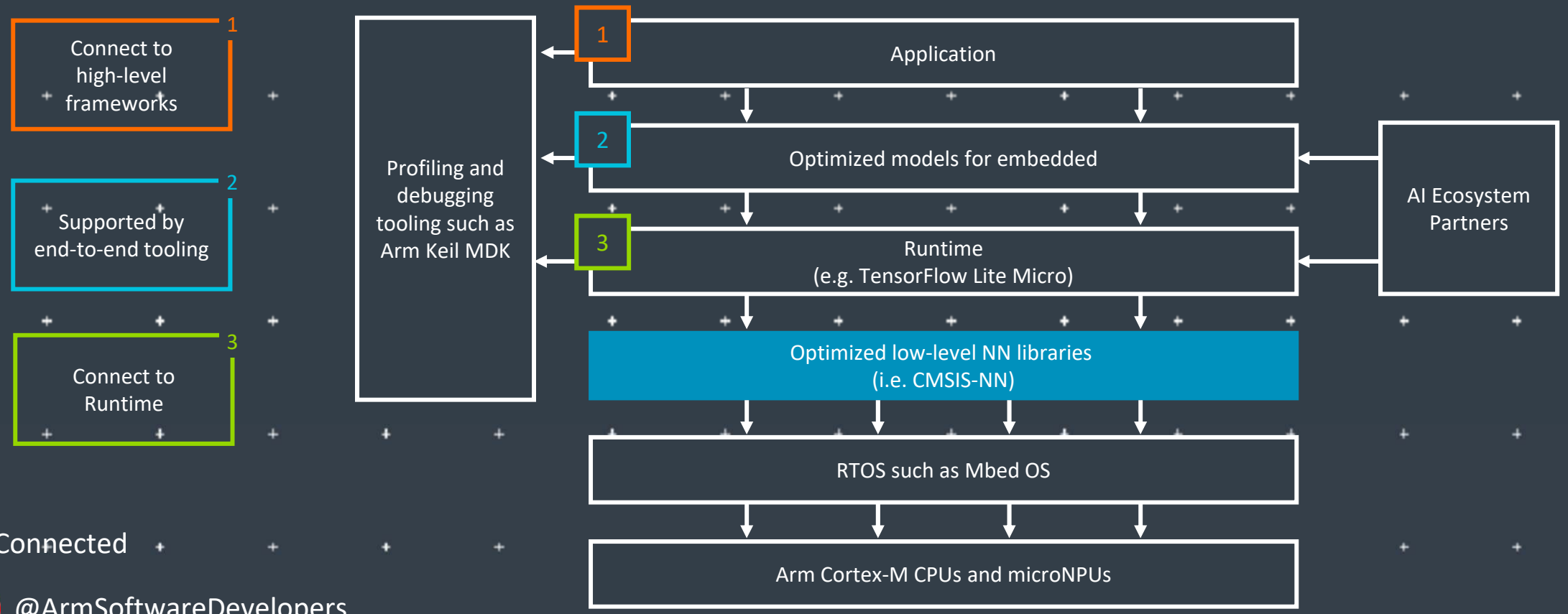

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Resources: developer.arm.com/solutions/machine-learning-on-arm

arm

TinyML for all developers

C++ library

Arduino library

WebAssembly

Dataset

Acquire valuable training data securely

Enrich data and train ML algorithms

Edge Device

Real sensors in real time

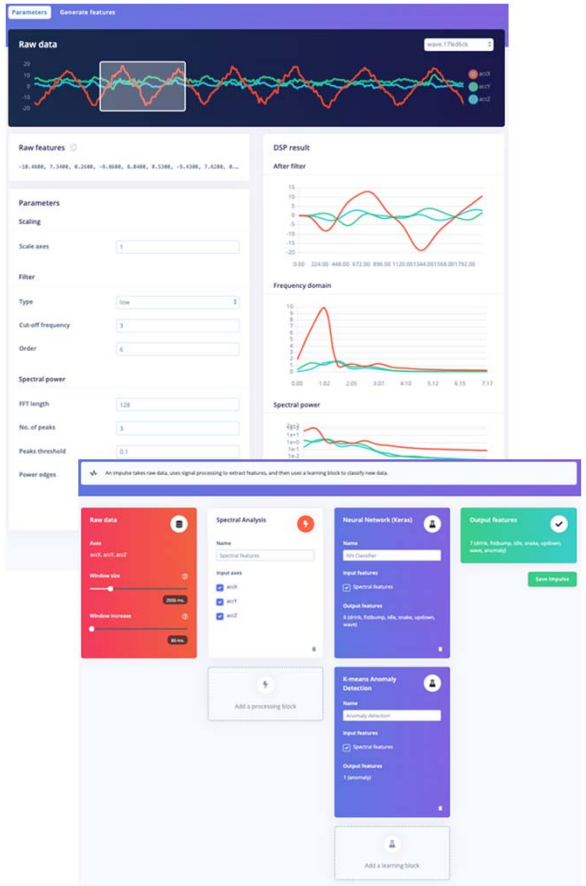
Open source SDK

Impulse

Embedded and edge compute deployment options

Test impulse with real-time device data flows

Test



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Power efficiency

Model design, compression, quantization, algorithms, efficient hardware, software tool

Personalization

Continuous learning, contextual, always-on, privacy-preserved, distributed learning

Efficient learning

Robust learning through minimal data, unsupervised learning, on-device learning

A platform to scale AI across the industry

Perception

Object detection, speech recognition, contextual fusion

Reasoning

Scene understanding, language understanding, behavior prediction

Action

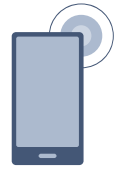
Reinforcement learning for decision making

Edge cloud

Cloud

IoT/IIoT

Automotive



Mobile

SYNTIANT

Syntiant Corp. is moving artificial intelligence and machine learning from the cloud to edge devices. Syntiant's chip solutions merge deep learning with semiconductor design to produce ultra-low-power, high performance, deep neural network processors. These network processors enable always-on applications in battery-powered devices, such as smartphones, smart speakers, earbuds, hearing aids, and laptops. Syntiant's Neural Decision Processors™ offer wake word, command word, and event detection in a chip for always-on voice and sensor applications.

Founded in 2017 and headquartered in Irvine, California, the company is backed by Amazon, Applied Materials, Atlantic Bridge Capital, Bosch, Intel Capital, Microsoft, Motorola, and others. Syntiant was recently named a CES® 2021 Best of Innovation Awards Honoree, shipped over 10M units worldwide, and unveiled the NDP120 part of the NDP10x family of inference engines for low-power applications.

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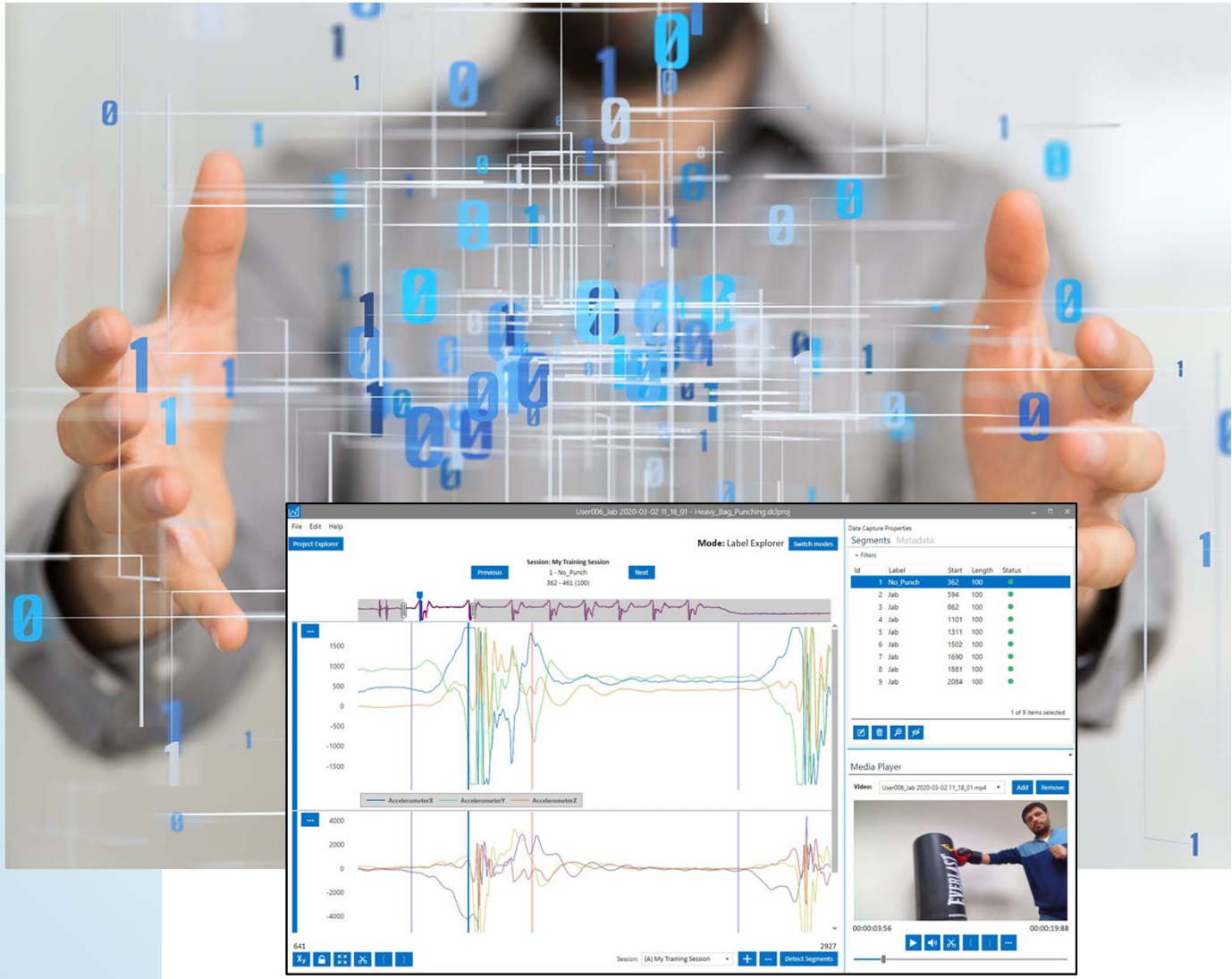
- Multi-user auto-labeling of time-series data
- Code transparency and customization at each step in the pipeline

We enable the creation of production-grade smart sensor devices.



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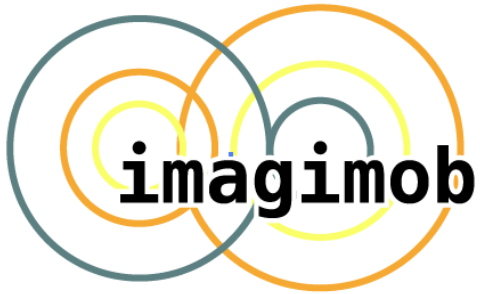

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