

How Battery-powered Intelligent Vision is Bringing AI to the IoT

October 5, 2021



Solve the Equation

$$AI + IoT = ?$$

A)



B)



C)



The AI Data Challenge

Top Data Challenges For AI

Quality



58% — Data quality issues



45% — Lack of well-curated data to train an AI system



40% — Data governance issues

Integration



54% — Lack of integration with data science/ML platforms



53% — Lack of integration with analytics/business intelligence platforms

Lack of understanding



52% — Lack of understanding of what our AI data needs are

Leads to low confidence data preparation for AI

40% lack confidence in ensuring data quality.

37% lack confidence in connecting multiple data sources.

52% lack confidence in their ability to successfully leverage data for AI.

The IoT Challenges

▪ Scalability

- vertical scalability: variability of computing resources of an IoT node
- horizontal scalability: addition or removal of an IoT node

▪ Security and Privacy

- interdependency of security, privacy, and trust for IoT ecosystems

▪ Self-Organization

- actively respond to the changing environments in an automatic and coordinated fashion

▪ Energy Efficiency

- current trend is to pack an energy constrained node with more and more functionality

*Grand Challenges in IoT and Sensor Networks – Frontier in
Communication and networks – Dec 2020*

Putting the Two Together

- According to the International Data Corporation, by 2025 the number of devices connected to the Internet will be around 42 billion, and a total of **80 zettabytes of data** will be generated in the same year.

Data Quality

Data Governance

AI integration

Data understanding



Scalability

Security and Privacy

Self-Organization

Energy Efficiency

The Solution: Sensor AI

1. Data is treated by the sensor ensuring high quality, no governance problem, complete integration and understanding
2. Naturally scalable with each AI enclosed in the sensor
3. No privacy issue, no data leak
4. Much more secure with very narrow attack surface
5. Sensor provide environment information in real-time, allowing IoT network self-organization and autonomy
6. If correctly designed, high energy efficiency can be reached

Intelligent Vision Anywhere

Energy-Constrained Environments

- Retrofits in existing sites
- Brownfield installations
- Remote sites
- Outdoor locations
- Infrastructure with limited power distribution



Batteries



Energy Harvesting



Energy limited

Unmet Industry Needs



Energy efficient vision
Long battery life (3+ years)



Zero maintenance



Security and Privacy



Rapid, easy deployment



Low cost

Required Solution

The most energy-efficient, accurate, and easy-to-deploy edge vision sensors



Flexible, easy-to-use, secure, low power connected vision sensor



Ultra-low energy AI for vision

What Does Battery-Powered Intelligent Vision Change?

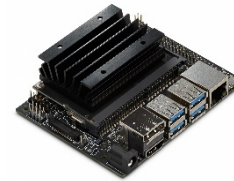
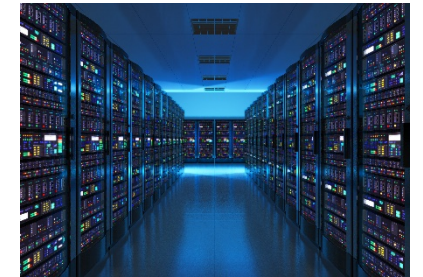
Tiny, battery-powered & low-power AI vision



- Fast, easy, low-cost installation
- No wires / No electrician
- Multi-year battery life
- Zero maintenance

Bulky, Line-Powered Cameras with Cloud-Based AI

VS.



- Expensive equipment and installation
- Lengthy and disruptive retrofits
- Electrician required (new wiring or renovation)
- The AI-IoT Data conundrum

Large and Growing Applications for Low-Power Vision AI

Smart Buildings



- Offices, classrooms, lobbies, elevators
- People detection & counting
- Space & asset utilization
- Safety and Compliance

Smart Cities & Transportation



- Smart buses / bus stops
- Parking, Digital signage
- People counting, crowd monitoring
- Fleet management
- Passenger information

Smart Factories



- Factories, plants, oil and gas
- Worker monitoring
- Machine monitoring, display digitization
- Safety & compliance
- Intrusion & security
- Automation

Retail / Logistics



- Store, Warehouse, Transit port, Airport
- Object detection and recognition
- People monitoring
- Shelf inventory
- No-tag asset tracking
- Shopper behavior

Use Case for Office Buildings: Room Occupancy

■ Goal

- Managing hybrid space requires accurate occupancy monitoring for best space allocation and user experience
- Reduce energy cost with accurate occupancy detection

■ Monitor number of people in various rooms

- Get instant view of local and total occupancy
- Record history and analyze occupancy and people flow during the day

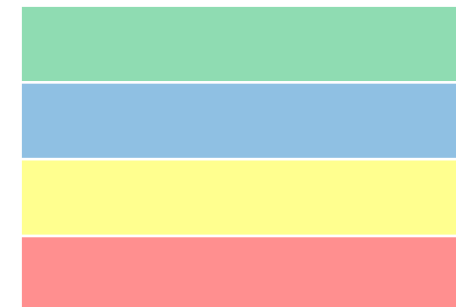


Vacant

Under capacity

At capacity

Exceed capacity



Use Case for Retail Stores: Traffic Measurement

■ Goal

- Optimize retail store staffing for peak hours
- Improve customer experience with less wait time and better service
- Adjust promotions vs traffic
- Comply with occupancy limits (COVID)

■ Monitor customer flow in the store

- Get instant view of occupancy and flow
- Record history and analyze occupancy and people flow during the day



Use Case for Transportation: Crowd Detection and Flow

■ Goal

- Demand management for fleet optimization
- Improve customer experience with less wait time and better information
- Digital signage monetization

■ Monitor crowd and people flow

- Get instant view of number of people waiting at the stop and in the vehicle
- Record history and analyze occupancy and people flow during the day



Battery-Operated People-Aware Doorway-Mounted Sensor



- **Accurately detects and track people entering and leaving a space**
 - Maintain people counts for conference rooms, breakrooms and enclosed offices, shops, classrooms, transport.
- **Battery operated with extended 3 years battery life**
 - Low installation cost and Low infrastructure cost
 - Low maintenance cost
- **Easy to integrate with existing networks and gateways**
 - Standard Bluetooth Low Energy (BLE) wireless interface
- **Private and secure**
 - Local processing, only meta data shared to the cloud
 - State of the art IoT security
- **Customizable**
 - Option for compliance and safety: Helmet, Smoking, Mask, Distancing
 - Flexible architecture allows for feature extension and custom use cases

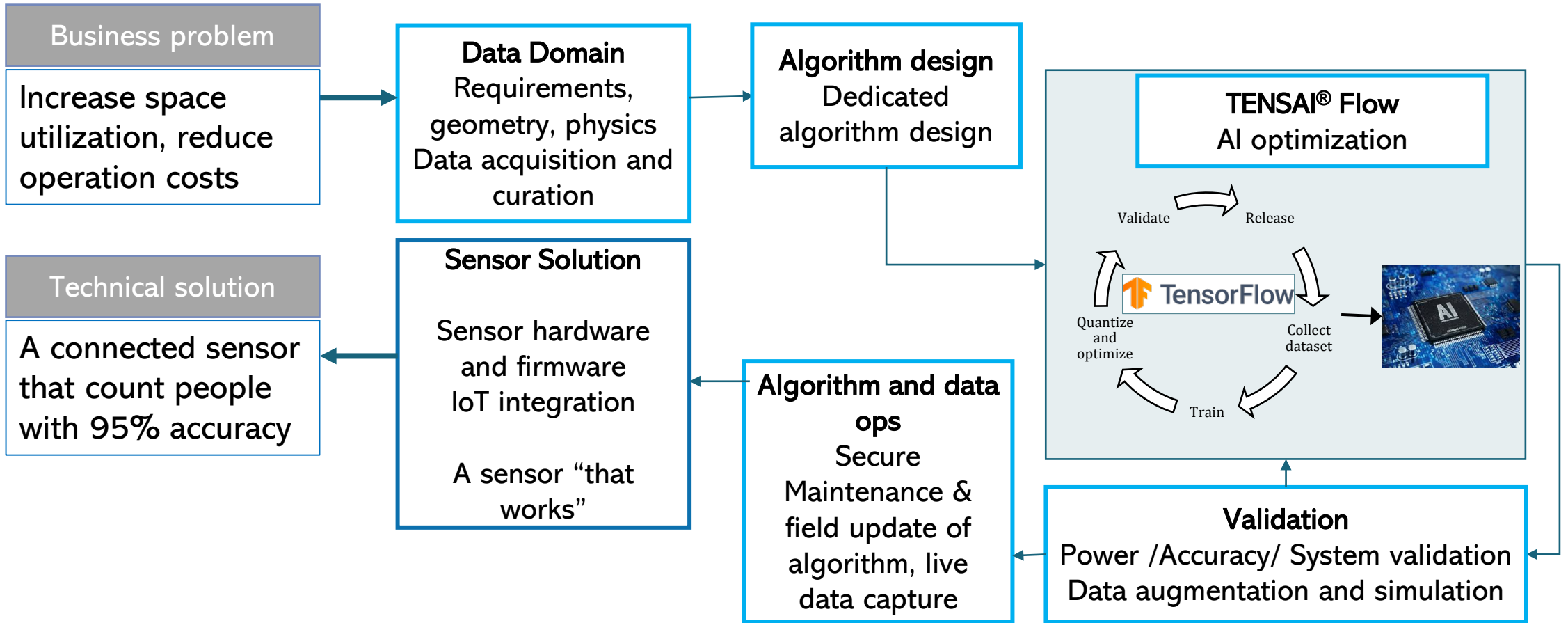
Algorithm Demo Video



Delivering the AI-IoT Gains



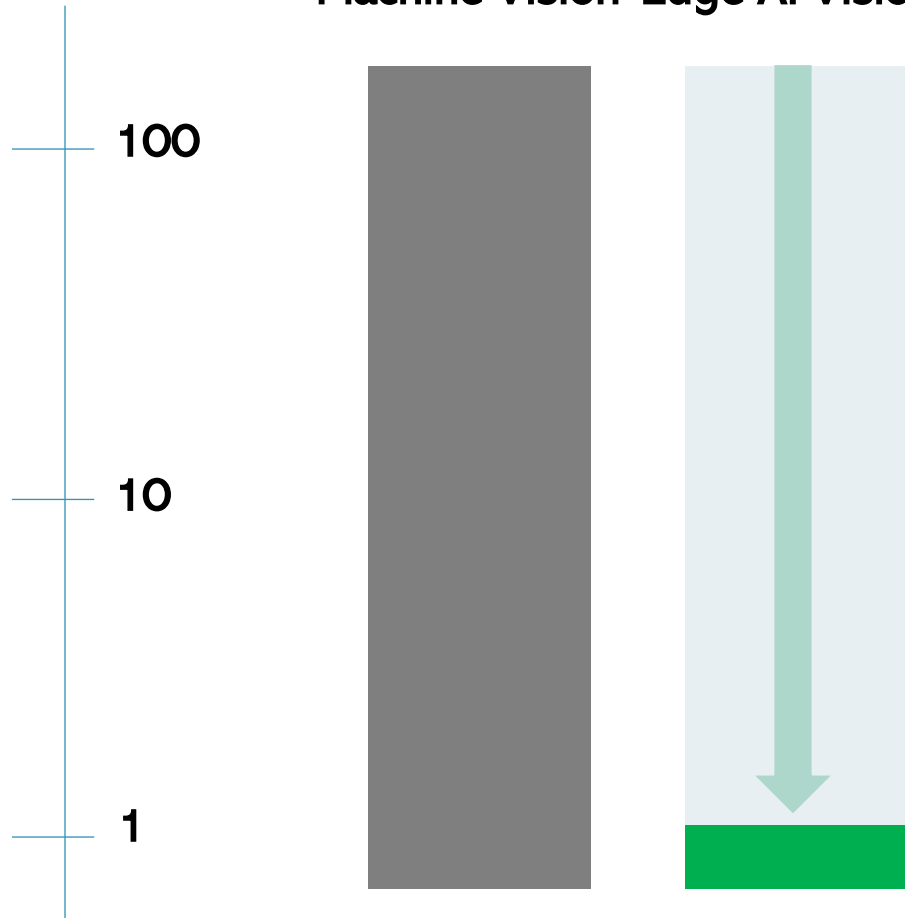
Inside the Magic



Micropower Edge AI for Vision

Power

Traditional Machine Vision Eta Compute Edge AI Vision



- Only meta –data transmission, no full video streaming
- μ Watt vision sensor design
- Use best available edge-AI inference processor
- Specific neural networks and algorithms for tiny machines
- Patented Tensai Flow tools to deliver the best ML optimization for multicore hardware

Use Case in Retail: Shelf Monitoring

- Low power, easy to deploy shelf sensors
 - Scalable from convenience store to big box - robust visual AI
 - On-sensor inferencing - no high-bandwidth networking, no expensive cloud infra
- Detects
 - Shelf condition: disorder, empty, clean
 - Planogram compliance
 - Inventory status
 - Events (customer presence, customer pick up, customer replace, restock)



Use Cases in Factories: Machine Monitoring

- Plant managers want also to know the time workers spend in front of machines and what they do
- Intelligent camera to monitor machine and workers
 - Stack light status and alerts
 - Worker activity: time and action



What Does the Future Look Like ?

Tesla Bot



**WORLD BUILT BY HUMANS,
FOR HUMANS**

FRIENDLY

**ELIMINATES DANGEROUS,
REPETITIVE, BORING TASKS**

**HEIGHT
5'8"**

**CARRY CAPACITY
45 LBS**

**WEIGHT
125 LBS**

**DEADLIFT
150 LBS**

**SPEED
5 MPH**

**ARM EXTEND LIFT
10 LBS**



T E S L A LIVE

Wholeheartedly Agree !

- Do what human do in a world built for humans – **with vision**
- Friendly, **respect privacy**
- Eliminate boring, dangerous, repetitive and **error-prone tasks like monitoring and checking**
- Our answer is just slightly less grandiose
 - But it does the job



Empowering Product Creators to Harness Edge AI and Vision



The Edge AI and Vision Alliance (www.edge-ai-vision.com) is a partnership of 100+ leading edge AI and vision technology and services suppliers, and solutions providers

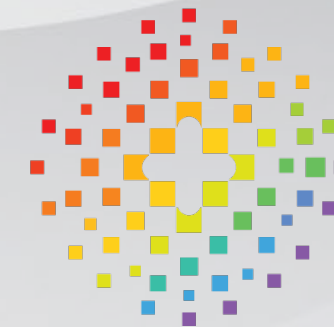
Mission: To inspire and empower engineers to design products that perceive and understand.

The Alliance provides low-cost, high-quality technical educational resources for product developers

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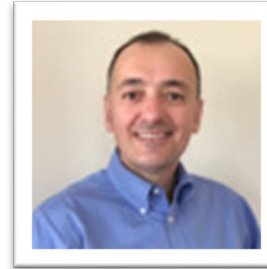
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Q&A

Have a question?

Please submit via Q&A



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Thank You!

