DEEP LEARNING – MACHINE VISION

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May 2021

SICK
Sensor Intelligence.

NOTES ON THE WEBINAR

- The Webinar will be recorded!
- If you would like to receive the presentation and / or the recording afterwards you have to sign **GDPR**!

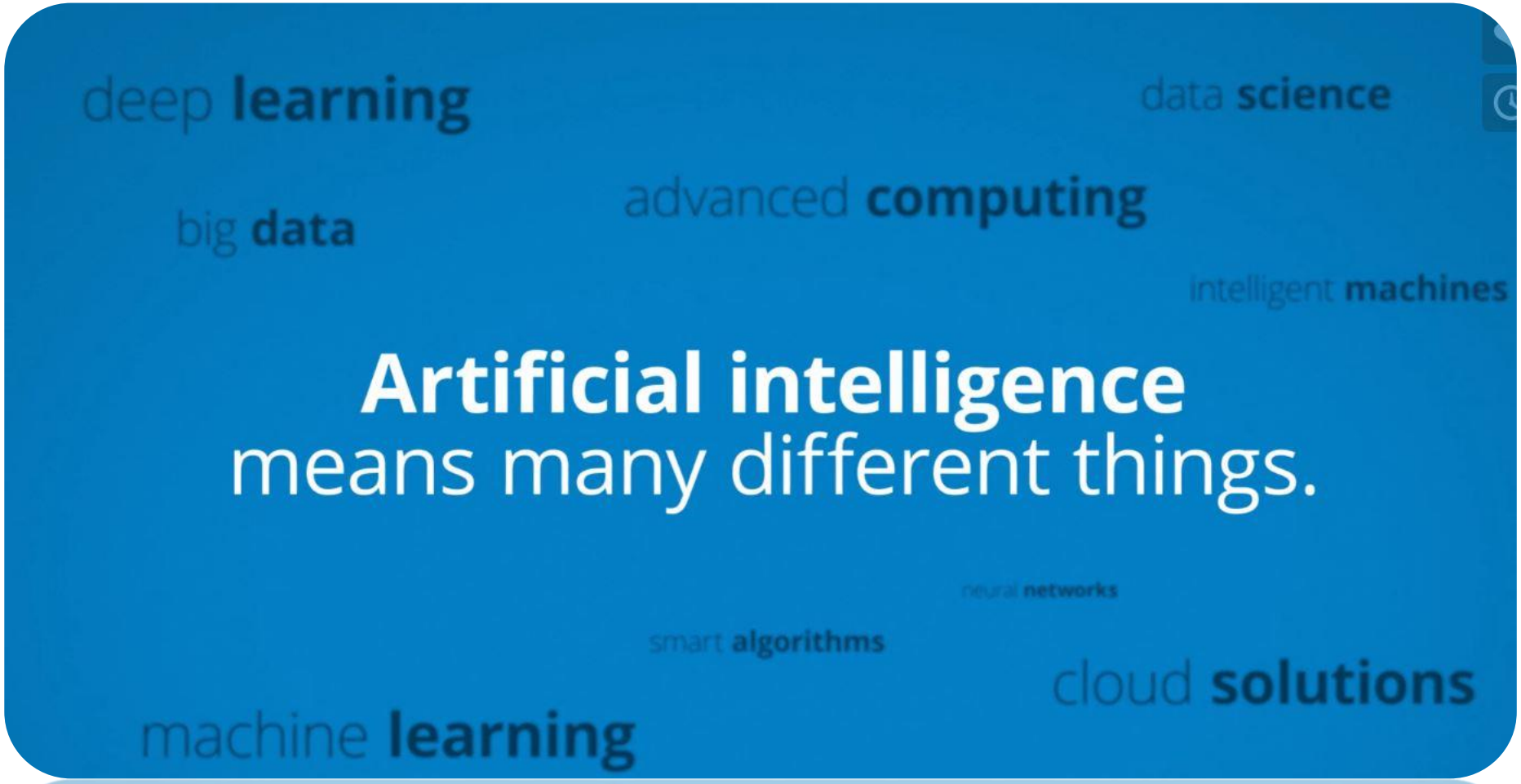
https://s.sick.com/newsletter_registration_at-de

Agenda

1. Introduction to and benefits with Deep Learning
2. Applications examples
3. Application buildup
4. SICKs Deep Learning product portfolio
5. Demonstration
6. sick.com/AI
7. Q&A

Introduction to and benefits with Deep Learning

What does AI / Deep Learning mean to SICK?



Artificial Intelligence

Technology

Artificial Intelligence (AI)

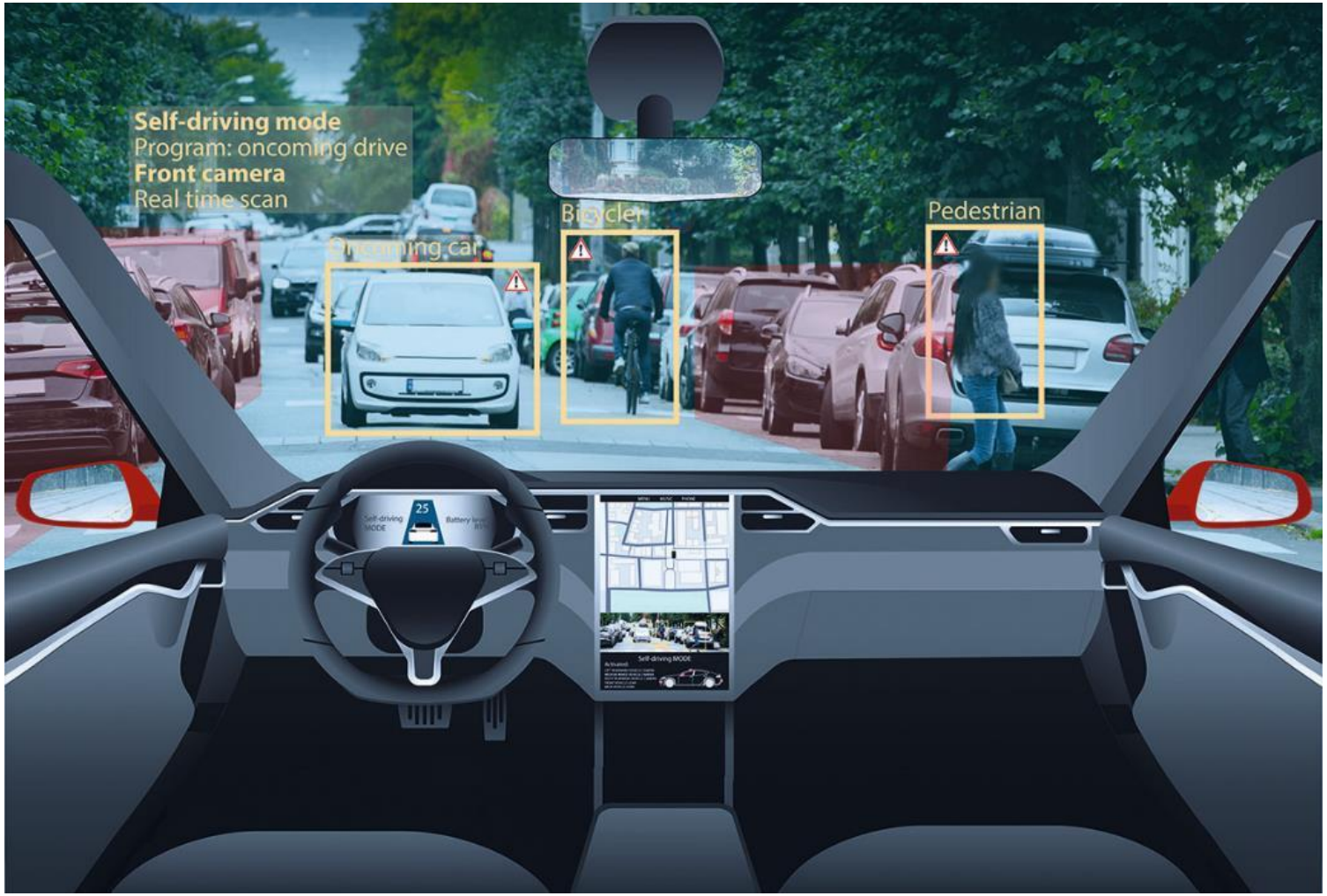
- is any technique that enables computers to mimic human decision making and problem solving
- In 2015, the AI program AlphaGo for the first time beat a processional Go player. Go is an abstract strategy board game

Deep Learning

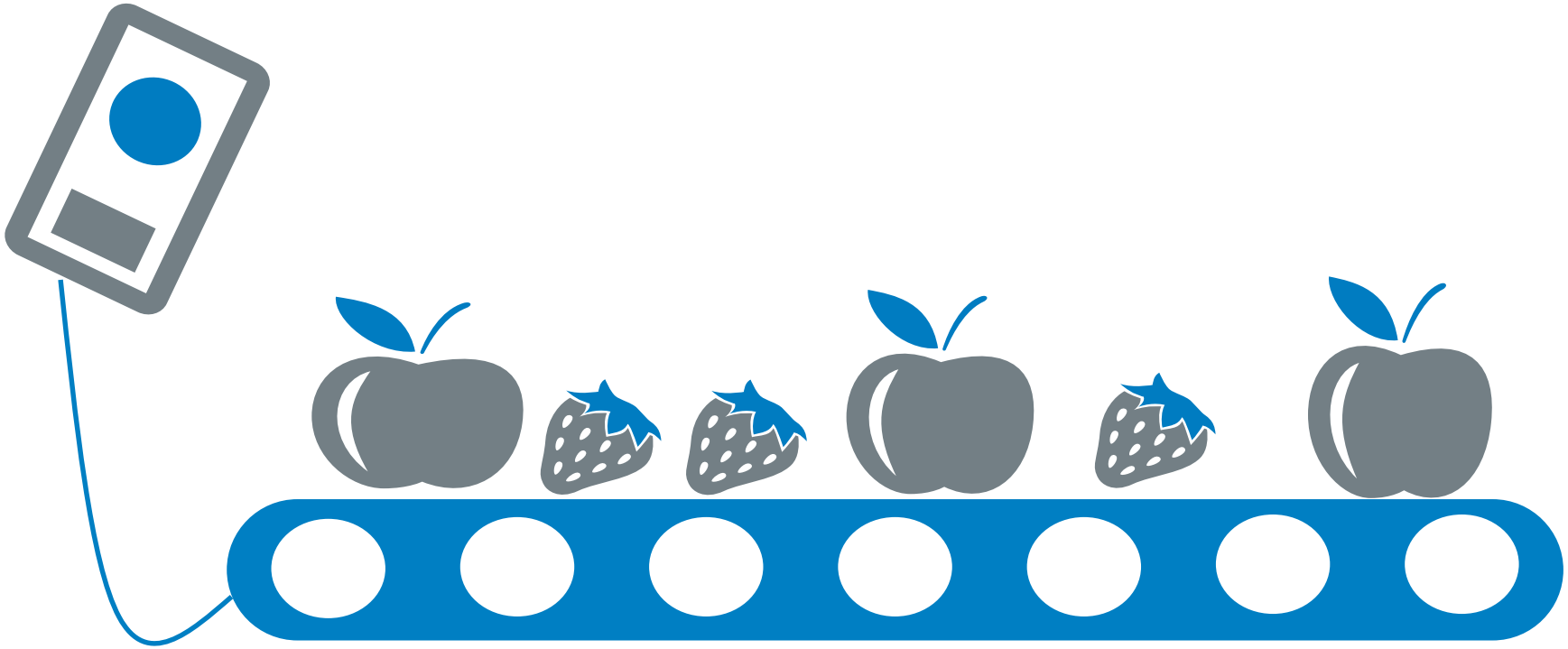
Technology

Deep Learning

- is a subset of Artificial Intelligence
- it enables computers to mimic human decision making and problem solving by finding patterns in data.
- Technology has been available for decades. With availability of data, computational power and open source algorithms adoption has increased

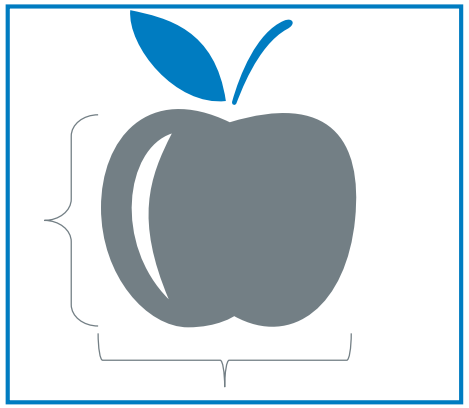


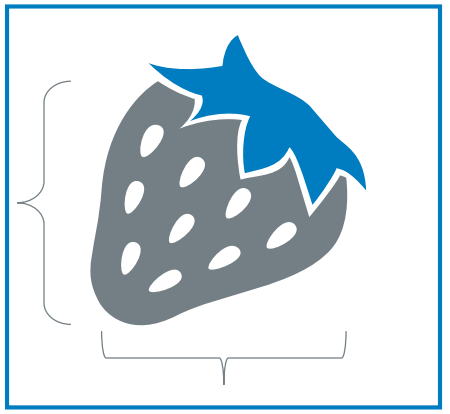
Sort fruits and berries



Rule based approach:

Rule based approach:
- Measurements between edges
- Pixel counter





But what if fruits and berries look like these?

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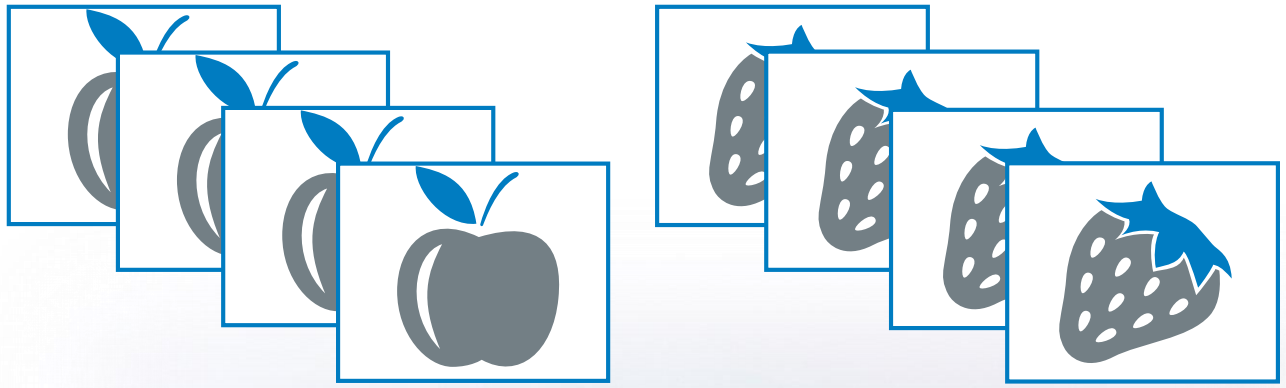
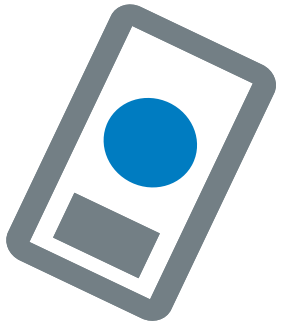
Example based approach

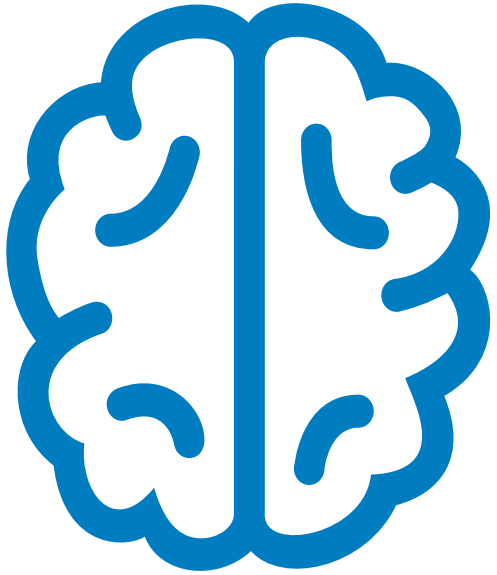
Example based approach:
› Similar to how human learns



Endurance and consistency with human perception



Endurance and consistency of a machine



Deep Learning

Human perception and flexibility

Application examples

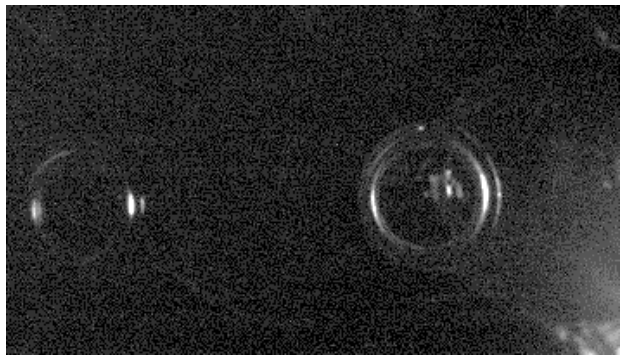
Application Examples

Sorting in consumer goods industry

Automated program-switching washer infeed

- New and returned bottles have different settings in the washing machine.
- Yesterday, the program switch was done manually
- Now, by using the Deep Learning classification tool the washer automatically adjust the speed depending on what type of bottle is present in the infeed zoon of the bottle washing machine
- Optimize water flow and reduce operators faults

Old bottles



New bottles

Application Examples

Sorting in wood industry

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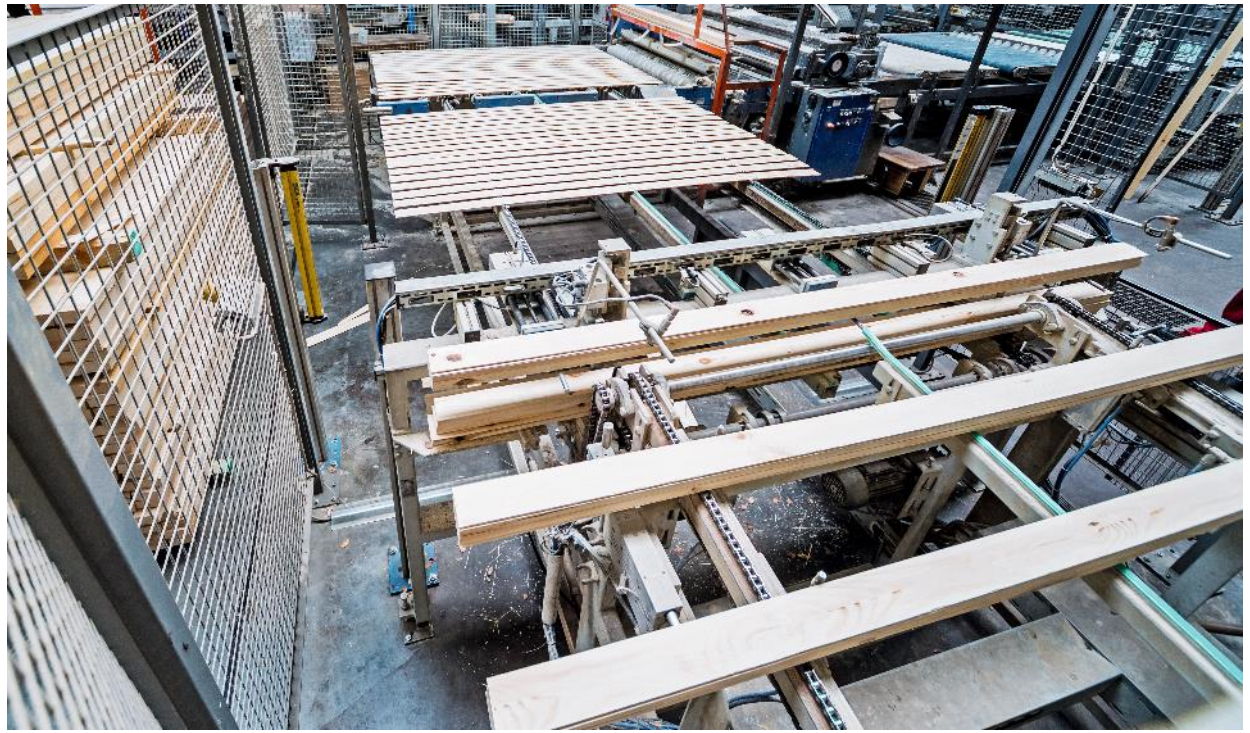
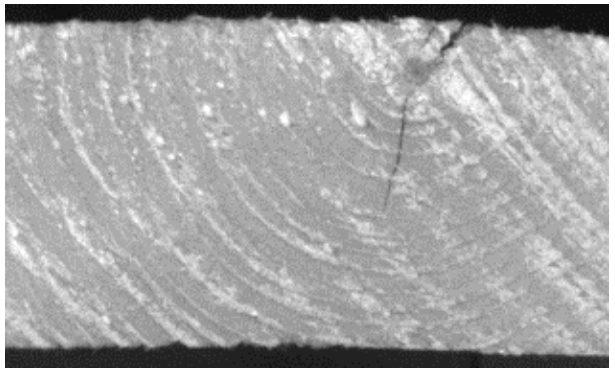
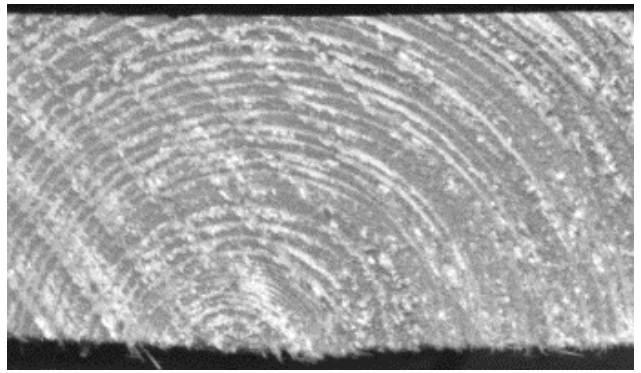
Automated wood flip

- Flip wood planks, based on annual ring structure, before processing machine in order to achieve high product quality
- Yesterday, this flip was done manually or by a traditional rule based machine vision system with not high enough accuracy.
- Now, by using the Deep Learning classification tool the plank is flipped with a human like accuracy





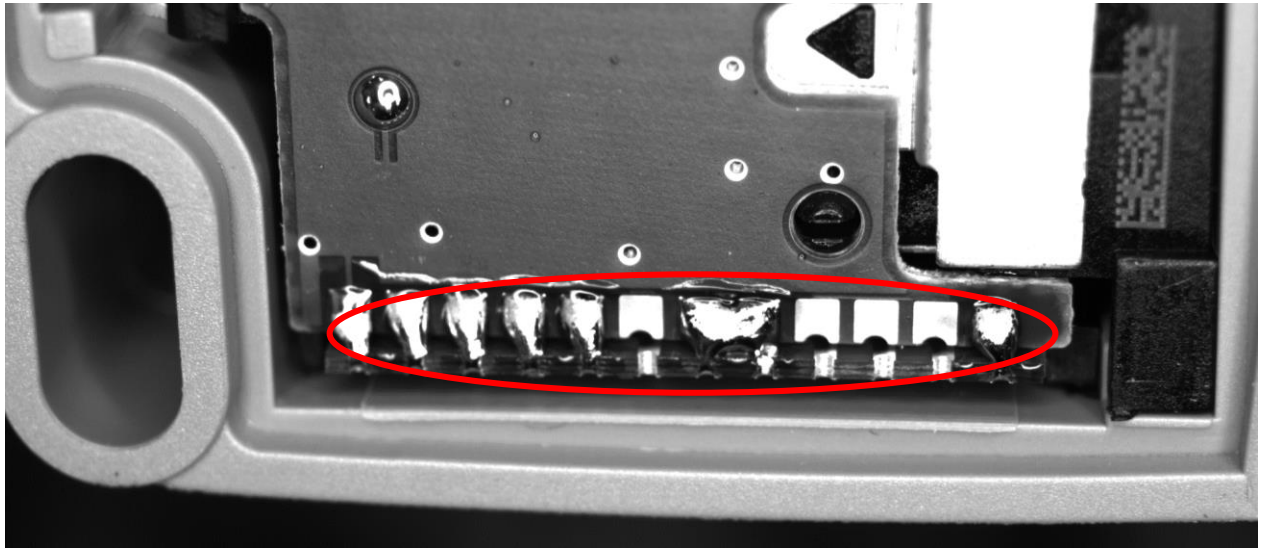
Annual ring up

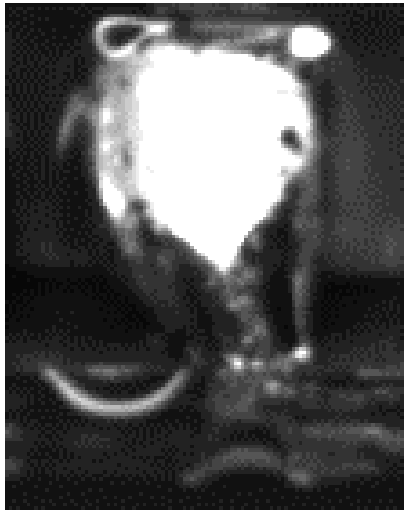


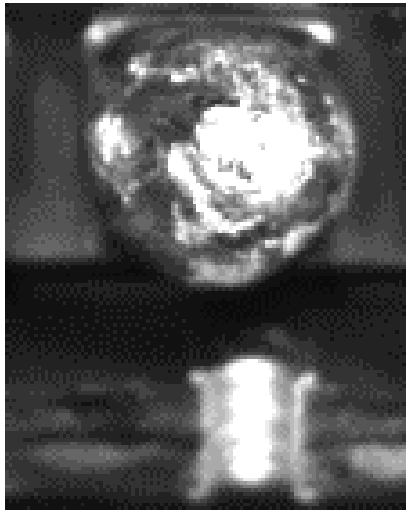
Annual ring down

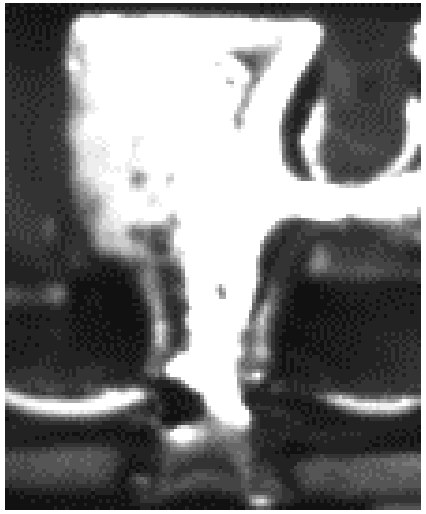
Application Examples

Defect classification in electronics industry









Clean contact

No contact

Short circuit

Defect classification of solders in electronics

- Good and bad soldering structures are difficult to predict with traditional rule based machine vision tools due to different appearance within the class
- Now, by using the Deep Learning classification tool the defects type are classified automatically with human like accuracy

Application Examples

Assembly verification in part manufacturing

Assembly verification in part manufacturing

- Verification of metal objects are difficult to predict with traditional rule based machine vision tools due to variation of its appearance
- By using the Deep Learning classification tool the assembly verification is done automatically with human like accuracy

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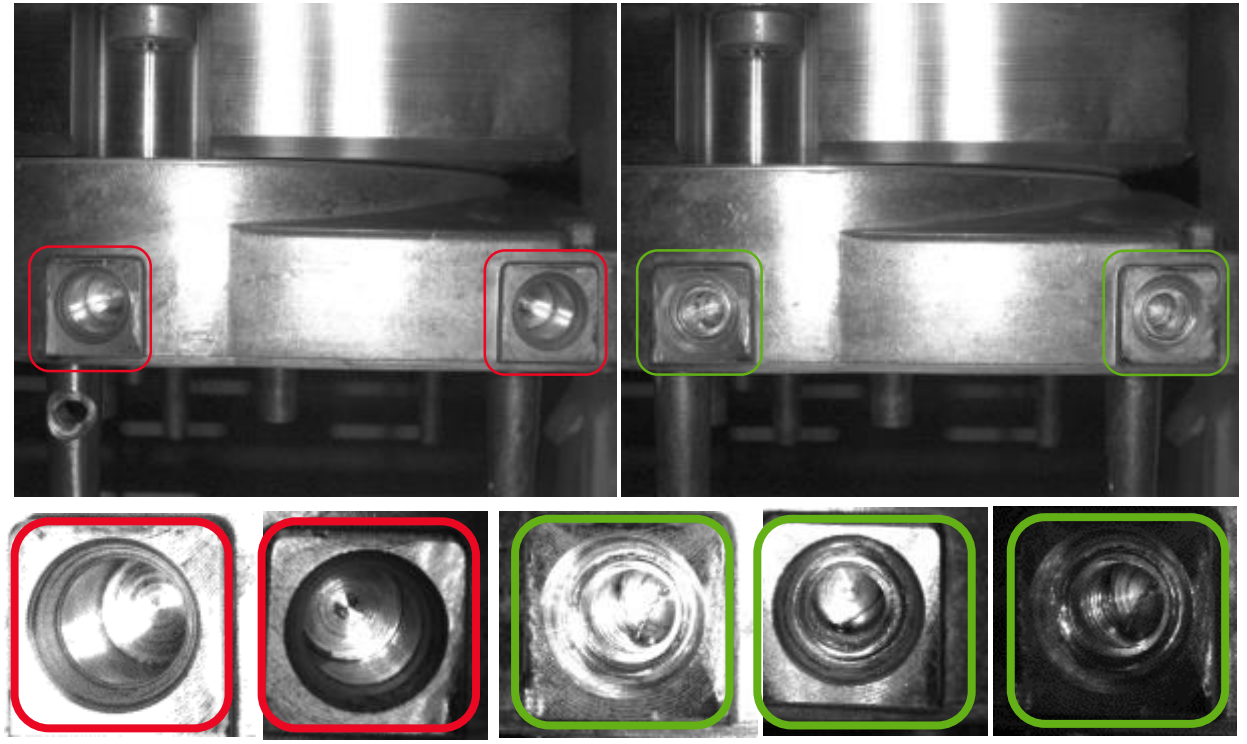

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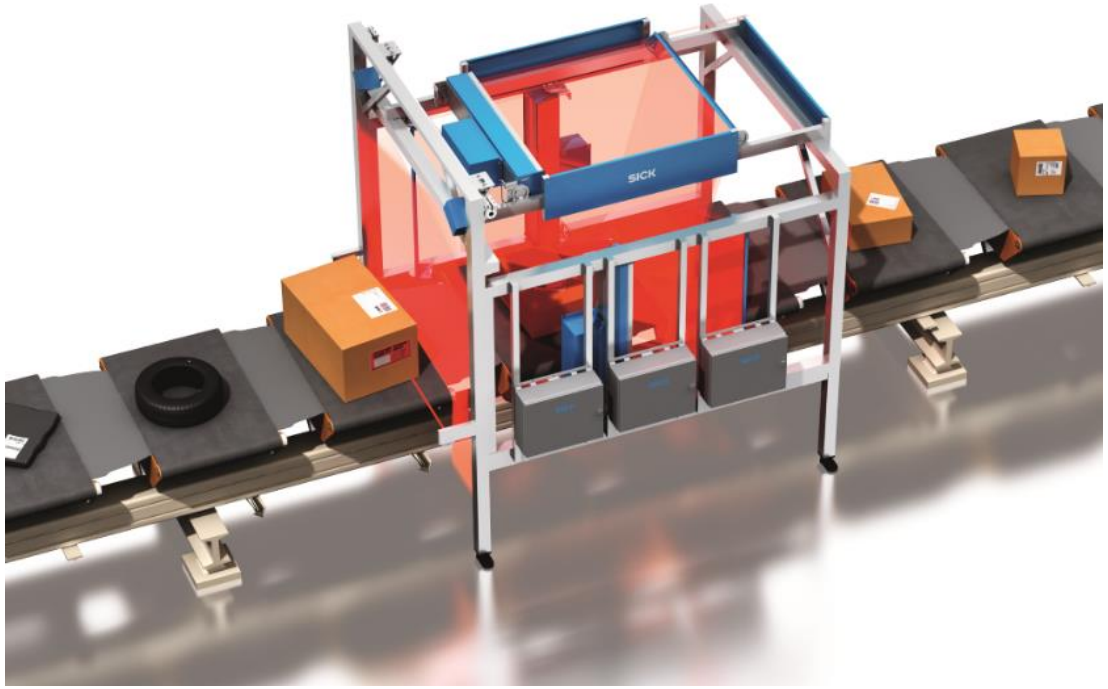
Application Examples – Systems Solutions

Single and multiple item detection



› **Single Item**

› **Multiple Items**

Simplified solution development in complex applications

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Rule based

Typical Object Characteristics:

> Well defined and specified objects

Application examples:

> Quality Inspection of well defined objects
> Barcode Reading
> Measurements
> Object Position Detection

Deep Learning

Typical Object Characteristics:

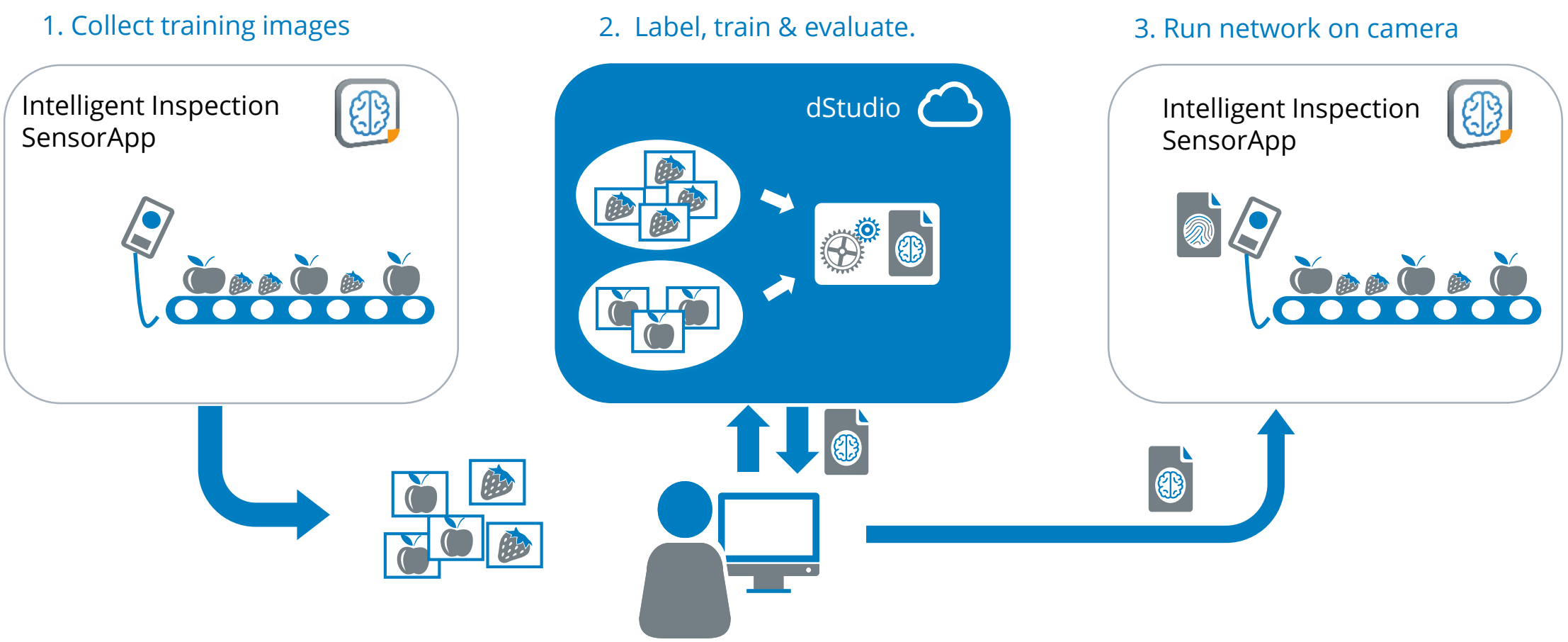
> Objects that very slightly, such as natural and grown objects, shiny objects or objects that change over time

Application examples:

> Sorting of objects with variances within the class
> Assembly verification
> Defect classification

Application buildup process

Application deployment process

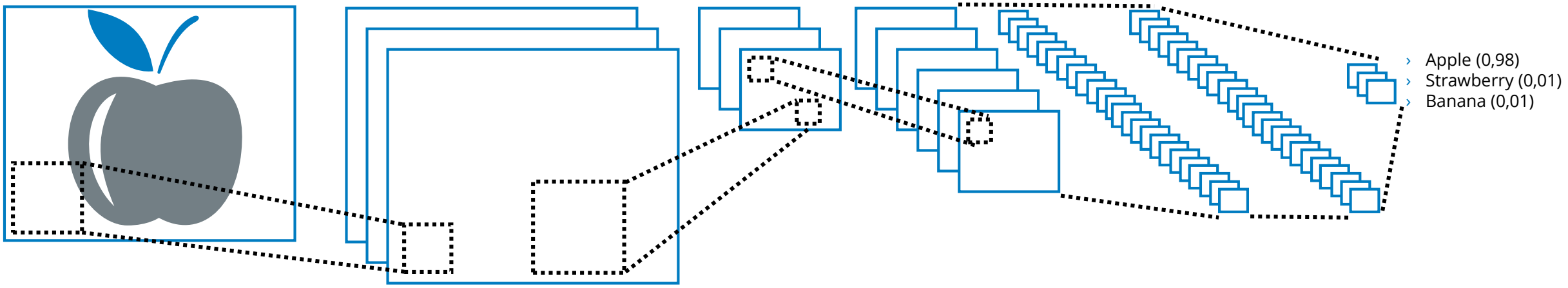


Convolutional neural networks

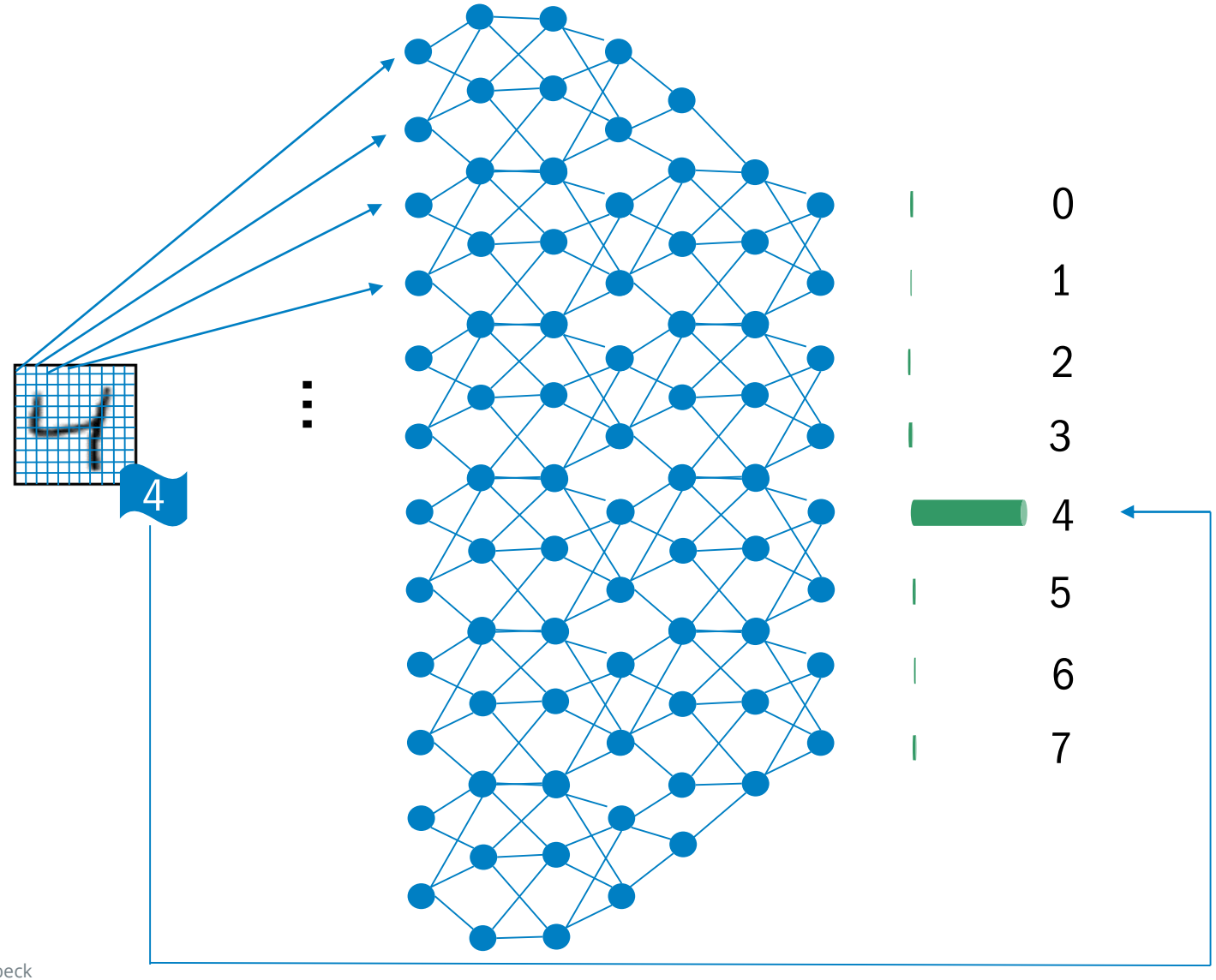
Technology

Deep Learning

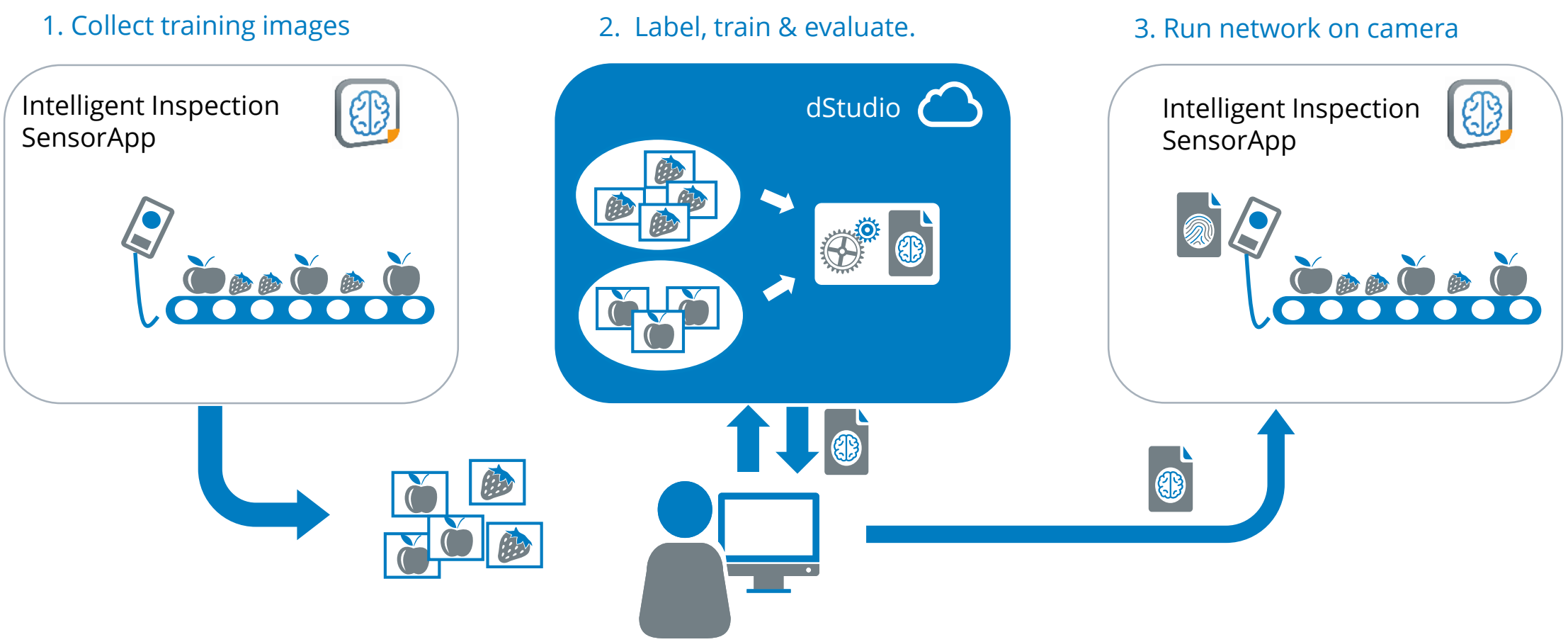
- Finds patterns in data using **convolutional neural networks** with **multiple layers**.
- Automatic and trained feature extraction.



Training Deep Neural Networks



Application deployment process



SICK Deep Learning Product Offering

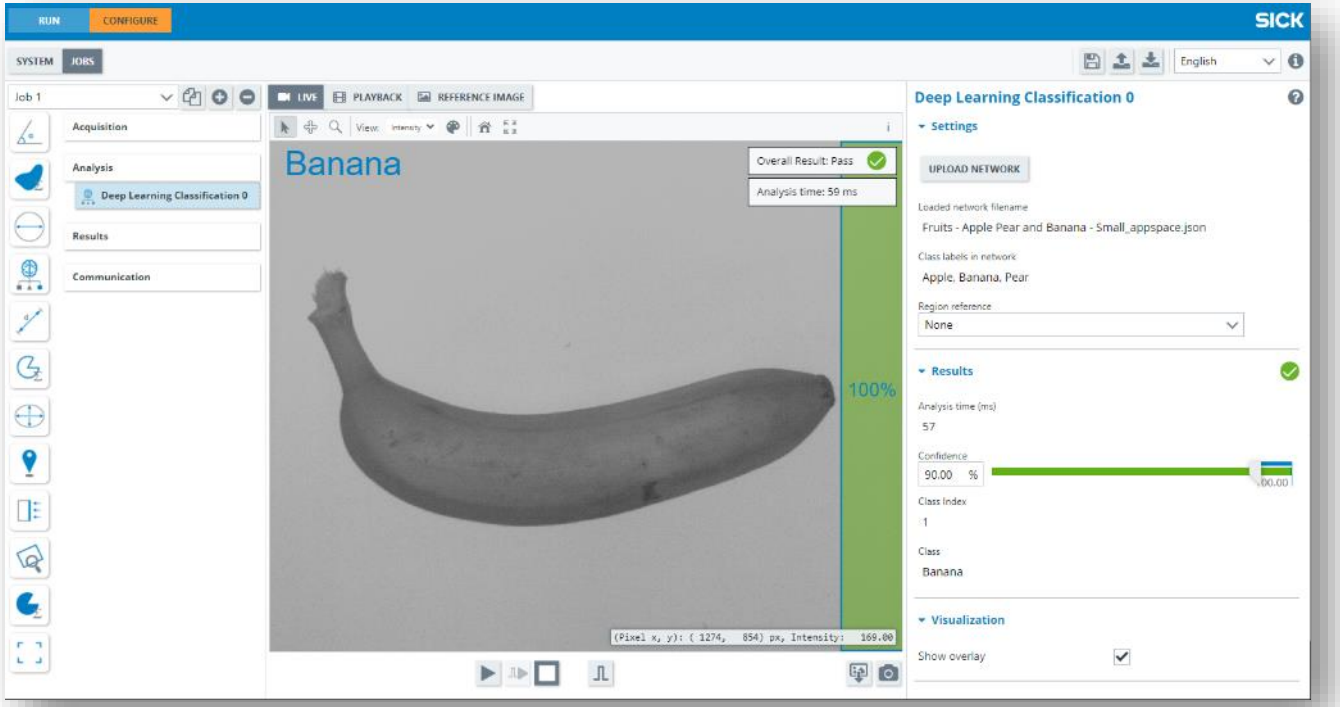
Deep Learning

Product component: Intelligent Inspection SensorApp

The Intelligent Inspection SensorApp from SICK ensures easy object classification that is not possible with traditional rule-based machine vision. The SensorApp is powered by deep learning technology and available as a licensed option when ordering InspectorP6xx 2D vision sensors from SICK.

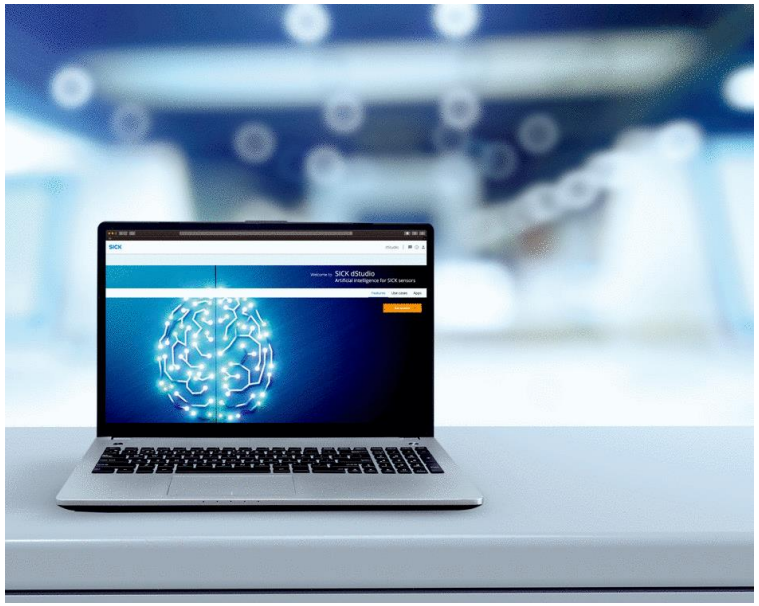
The example-based approach and easy-to-use user interface makes it quick to learn and paves the way for simplified solution development. The user can easily collect training data to be used in the neural network training, and deploy the trained network directly on the sensor without the need for any extra equipment.

In addition, traditional rule-based machine vision software tools are included.



Deep Learning

Product component: dStudio



dStudio for cloud based classification training

- Intuitive training experience
- No additional hardware or software required for training
- Neural networks are optimized for SICK devices.
- No profound machine learning expertise required
- Free trial offering available (120 minutes per device restart)

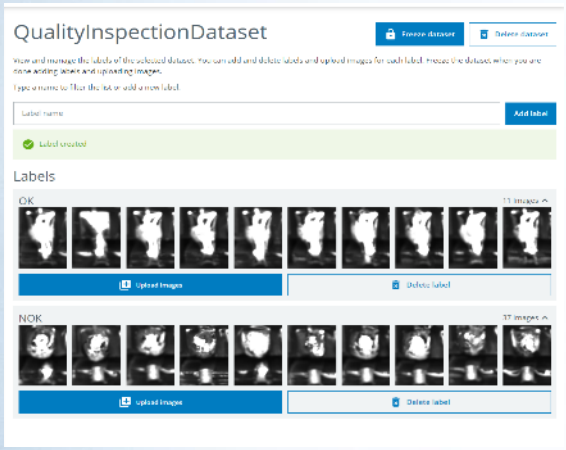
Pay per trained network file

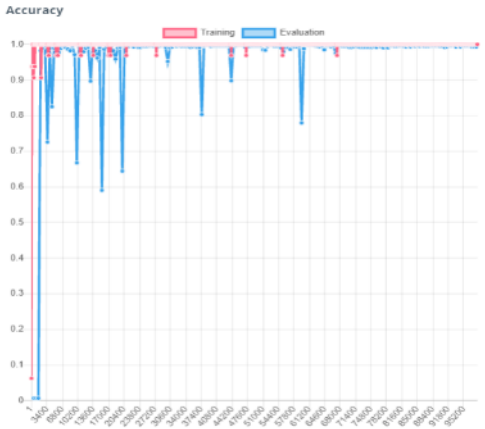
- Training and evaluation is free of charge
- A one time payment per trained model is required for productive usage (via prepaid tokens)
- Trained network can be deployed to unlimited number of devices

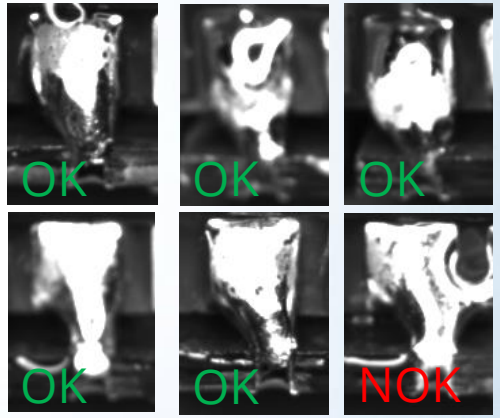
Deep Learning

https://dStudio.cloud.sick.com

A successful image classification training in just a few steps:







1. Create Dataset

- Upload images sorted in classes

2. Run Classification Training

- Select network according to required inference time
- Train that network with your dataset
- Monitor training success

3. Evaluate Training Result

- Automatic evaluation after training accomplishment
- Visual feedback helps to further improve the setup

4. Deploy Trained Network

- Free trial option
- Purchase your trained neural network for productive usage

dStudio

Security

Your data is safe

Security of customer data is of utmost importance to SICK. To ensure confidentiality, integrity and availability of data confided to SICK, a large number of measures are taken:

- User authentication with SICK ID:
  - Externalized user management minimizes exposure of sensitive data and personal identifiable information.
  - Pen tests passed (executed by external company)
  - Authorization tokens invalidated after some minutes.

- All connections from and to our cloud are secure using either TLS (https), SFTP/SSH or IPsec.

- Data-at-rest encryption: Persisted data is encrypted (AEAD) with state-of-the-art crypto.

- Minimal attack surface by switching off all unnecessary services and open ports.

- Monitoring on our services to detect suspicious behaviors

Deep Learning

Product component: Deep Learning Classification License

Deep Learning Classification License

- Enables image classification with deep neural networks directly on suitable programmable SICK devices
- Available for InspectorP and SIM (as of May 2021). More product families will follow.
- Ready to use sensor apps like e.g. Intelligent Inspection on InspectorP are available
- Create your individual Deep Learning sensor app with SICK AppSpace
- Free trial offering available (120 minutes per device restart)

- One license can be used on one device
- For an unrestricted usage, also a neural network trained with dStudio must be purchased
- License activation guide will be provided with license key

Deep Learning

Product component: Deep Learning Classification License and supported hardware

Deep Learning Classification License

- Available for all InspectorP 2D vision sensors
- Configurable with onboard possessing
- 1.2 MP to 4.2 MP Monochrome

+

Deep Learning

Product component: Deep Learning Classification License and supported hardware

Deep Learning Classification License

- Available for Sensor Integration Machine (SIM) 1012 and 4000 (entire family supported during summer)
- Combined with streaming cameras Midi or Picocam
- 1.6 MP to 12.3 MP color and monochrome

Demonstration

Demonstration

InspectorP621 vision sensor and Intelligent Inspection SensorApp

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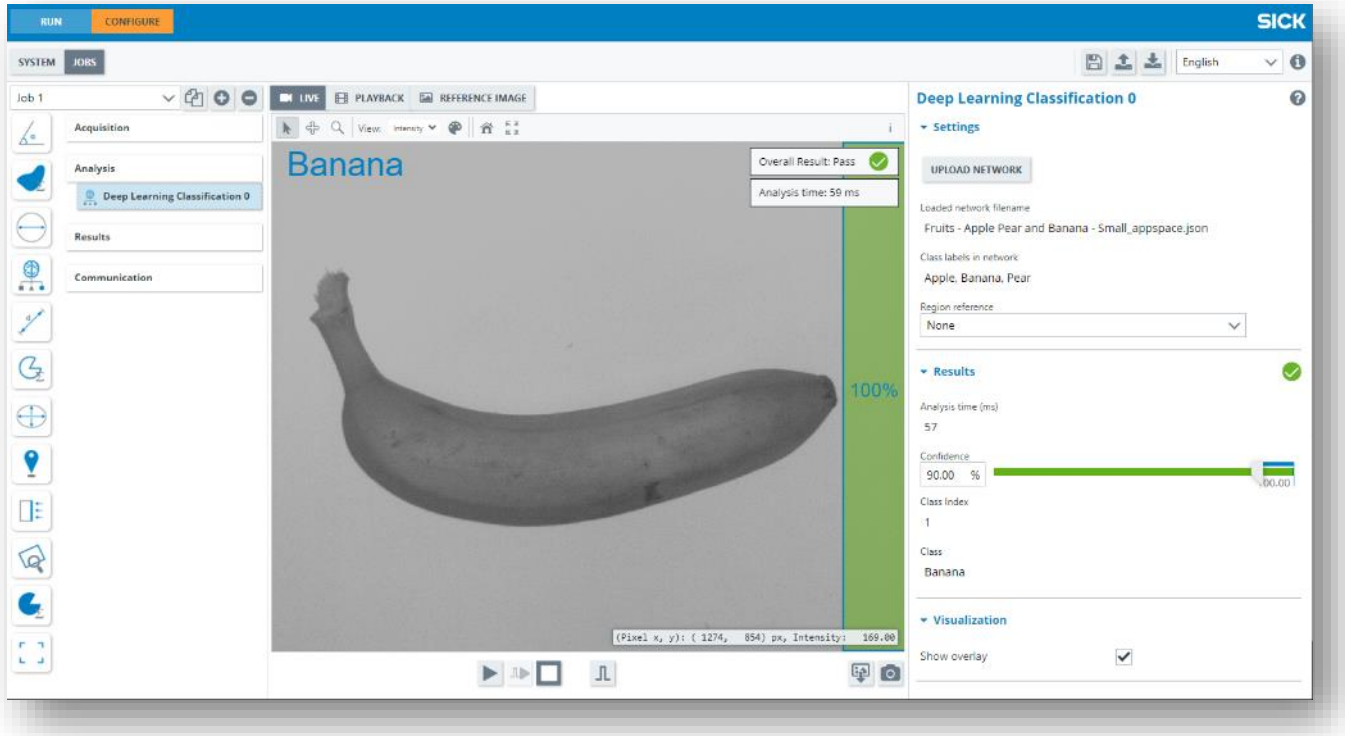

Deep Learning

Benefits summary

- Automate complex applications
  → Classify images that could only be assessed by humans so far.

- Reduced time and costs for implementation
  → Using SICKs deep learning portfolio is easy – no coding required

- Steady and accurate classification
  → Reach higher process/product quality across shifts and sites

- Increased efficiency
  → Detect defective parts earlier in the value creation process

- Execute the inference directly on the device
  → Reduce costs and complexity of your installation

Sick.com/AI

Q&A

THANK YOU FOR YOUR ATTENTION

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