



# DSAI - GREEN DATA SCIENCE

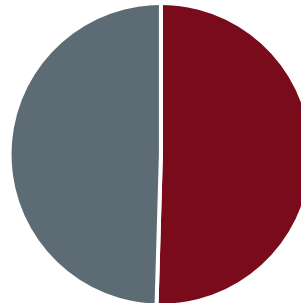
Clemens Heistracher, Axel Weißefeld, 21.08.2023

# AIT - AUSTRIAN INSTITUTE OF TECHNOLOGY



## OWNERSHIP STRUCTURE

**49.54 %**  
FEDERATION OF AUSTRIAN INDUSTRIES



**50.46 %**

REPUBLIC OF AUSTRIA  
(through the Federal Ministry for Transport, Innovation and Technology)

**EMPLOYEES**  
**1.400**

# DSAI

## R&D TOPICS

### Cultural Data Science

- FAIR Data Principles
- Digital Preservation
- Electronic Archiving
- Culturomics

### Industrial Data Science

- Digitalisation
- Industry 4.0
- Blockchain technologies
- Predictive Maintenance

### Data Science for Public Security

- Virtual Assets and DeFi
- Consumer Protection
- Disinformation
- Hybrid Threats

### Green Data Science

- Climate Change
- Forestry
- Agriculture
- *Circular Economy*

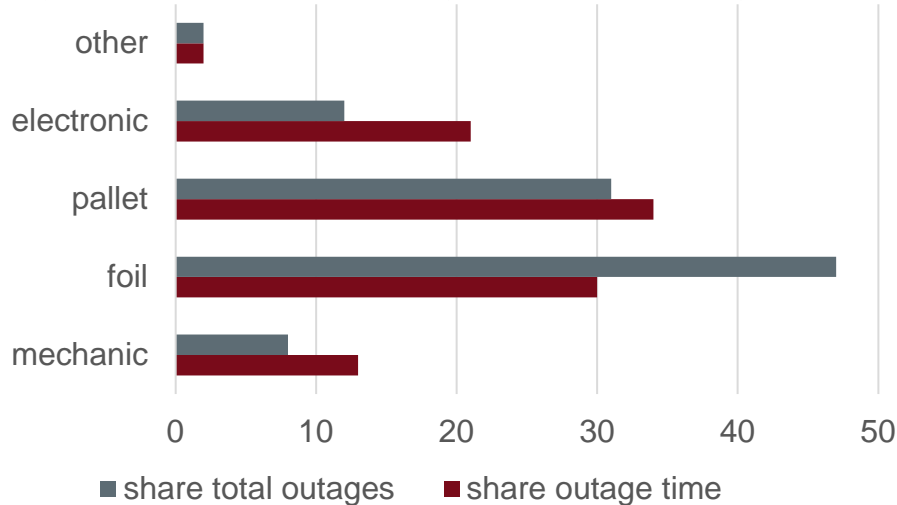
# DSAI

## R&D TOPICS

Cultural Data Science	Industrial Data Science	Data Science for Public Security	Green Data Science
<ul style="list-style-type: none"><li>• FAIR Data Principles</li><li>• Digital Preservation</li><li>• Electronic Archiving</li><li>• Culturomics</li></ul>	<ul style="list-style-type: none"><li>• Digitalisation</li><li>• Industry 4.0</li><li>• Blockchain technologies</li><li>• Predictive Maintenance</li></ul>	<ul style="list-style-type: none"><li>• Virtual Assets and DeFi</li><li>• Consumer Protection</li><li>• Disinformation</li><li>• Hybrid Threats</li></ul>	<ul style="list-style-type: none"><li>• Climate Change</li><li>• Forestry</li><li>• Agriculture</li><li>• <i>Circular Economy</i></li></ul>
<p>Ground Truth</p> <ul style="list-style-type: none"><li>• Transcription</li><li>• Annotation</li></ul>	<p>Explainable AI</p> <ul style="list-style-type: none"><li>• Anomaly Detection</li><li>• Predictive Maintenance</li><li>• Predictive Analytics</li><li>• Computer Vision</li></ul>	<p>Multimodal AI</p> <ul style="list-style-type: none"><li>• Image, Audio, Video</li><li>• NLP</li><li>• Ethical Aspects</li></ul>	<p>Physics-informed AI</p> <p>Energy efficient DL</p> <p>Data fusion</p> <ul style="list-style-type: none"><li>• Remote sensing</li><li>• Laser Scanning</li><li>• Weather and climate</li></ul>

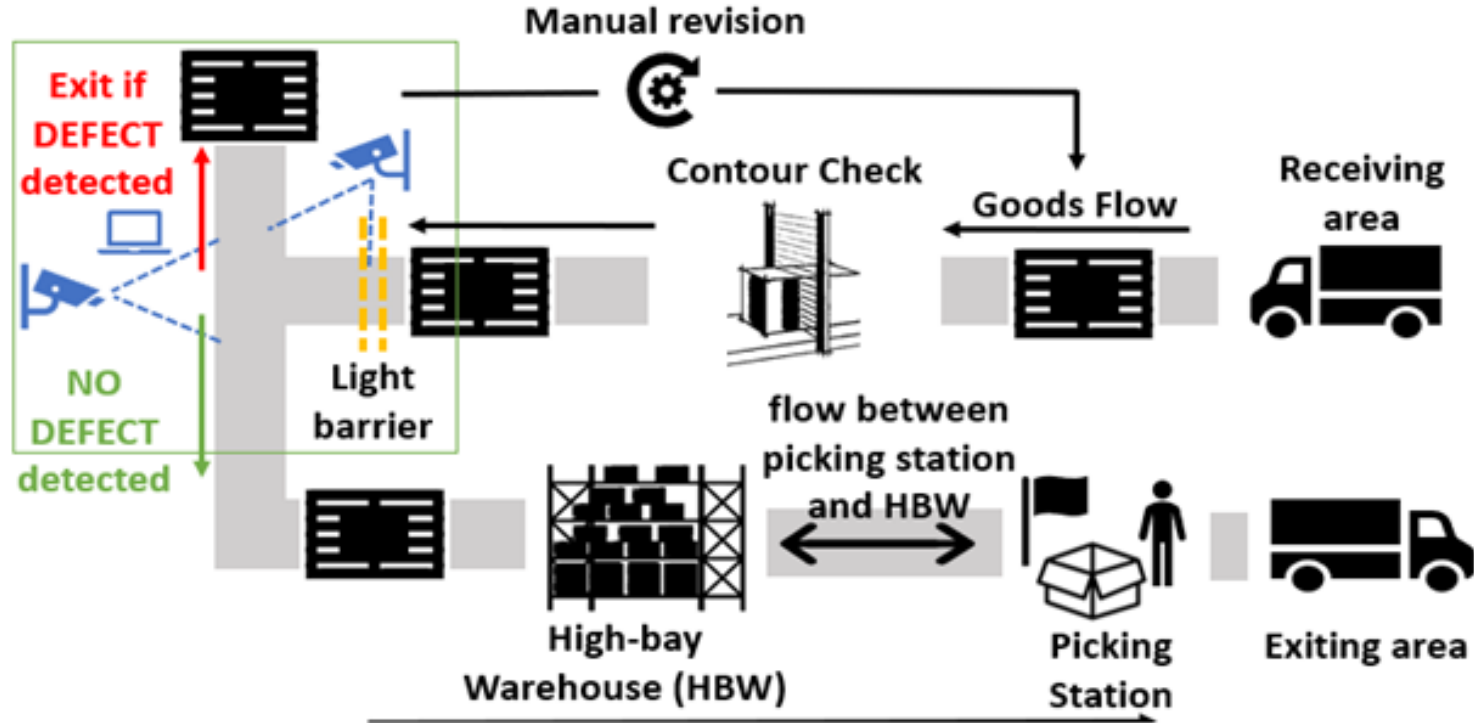
# COMPUTER VISION-BASED APPROACH TO REDUCE SYSTEM DOWNTIMES IN AN AUTOMATED HIGH-RACK LOGISTICS WAREHOUSE

- FFG / IKT der Zukunft 2019
- Partners: AIT (consortium lead), FhA, LineMetrics, Swarovski, SPAR
- EUR pallets circulate by the millions and play an important role in enabling short and long distance logistics in food retail
- System downtimes in the high-rack warehouse per error category:

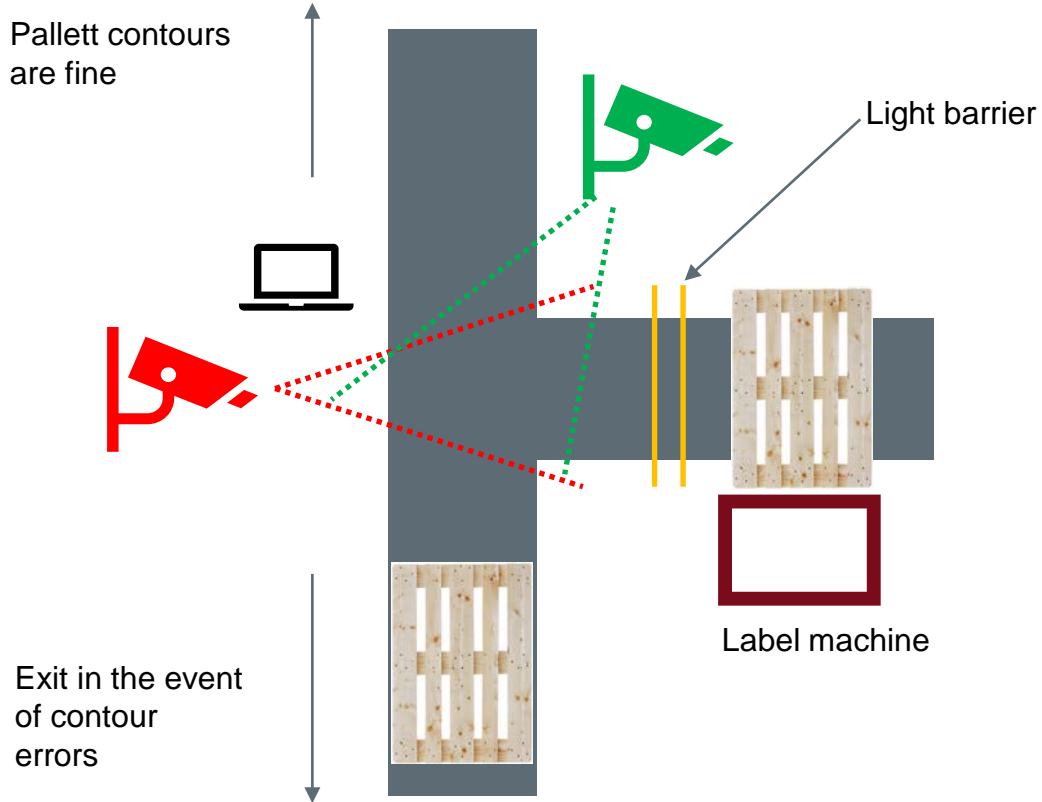


"Hochregallager für Europaletten der WM-Group in Duisburg" by Mdoornself CC BY 4.0.

# GOODS FLOW IN LOGISTICS CENTER

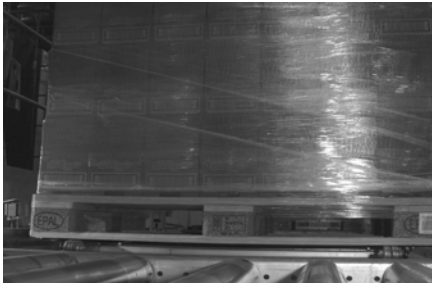


# HOCHREGALLAGEREINGANG: PALETTEN- ZUSTANDSAUFNAHME ->SET-UP



# HOCHREGALLAGEREINGANG: PALETTEN- ZUSTANDSAUFNAHME -> BEISPIELBILDER

VP 1



VP 3



VP 5



VP 2



VP 4

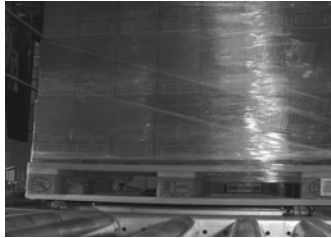


VP 6

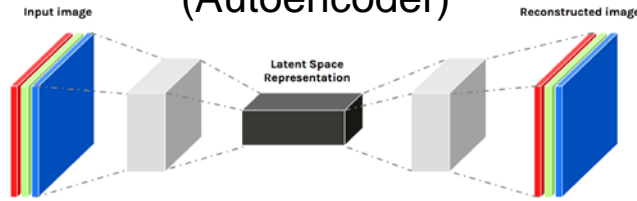




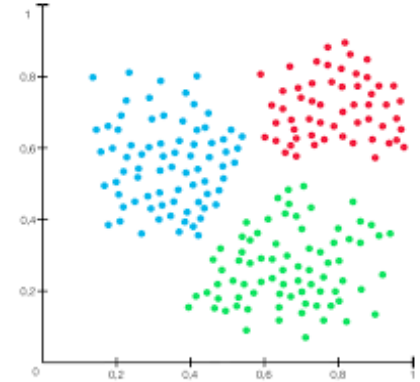
# COMPUTER VISION – KI PROZESSABLAUF



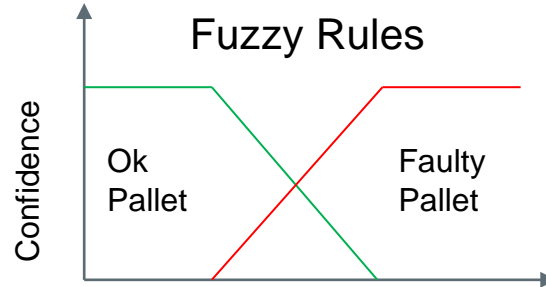
## Deep Learning (Autoencoder)



## Clustering

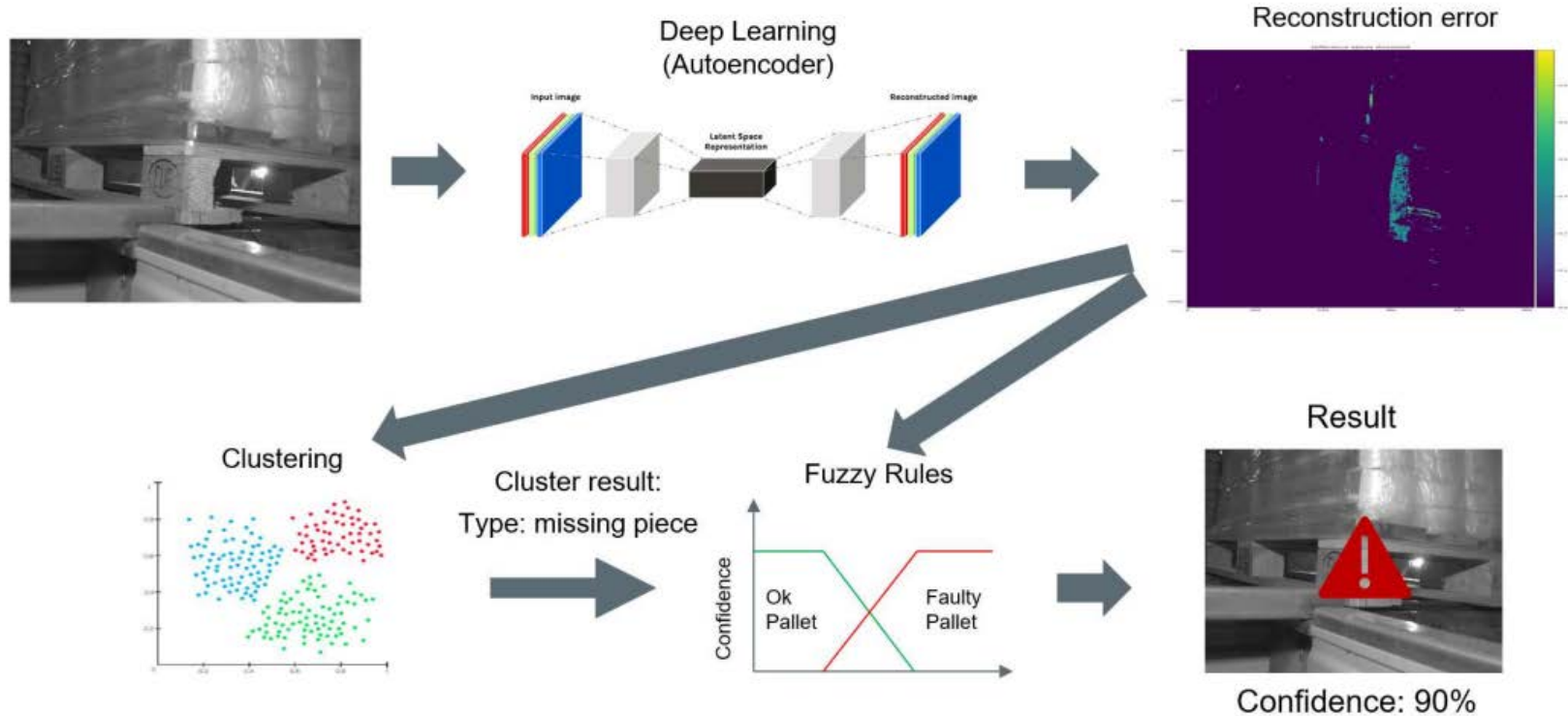


## Fuzzy Rules



Confidence: 90%

# AI-BASED COMPUTER VISION APPROACH

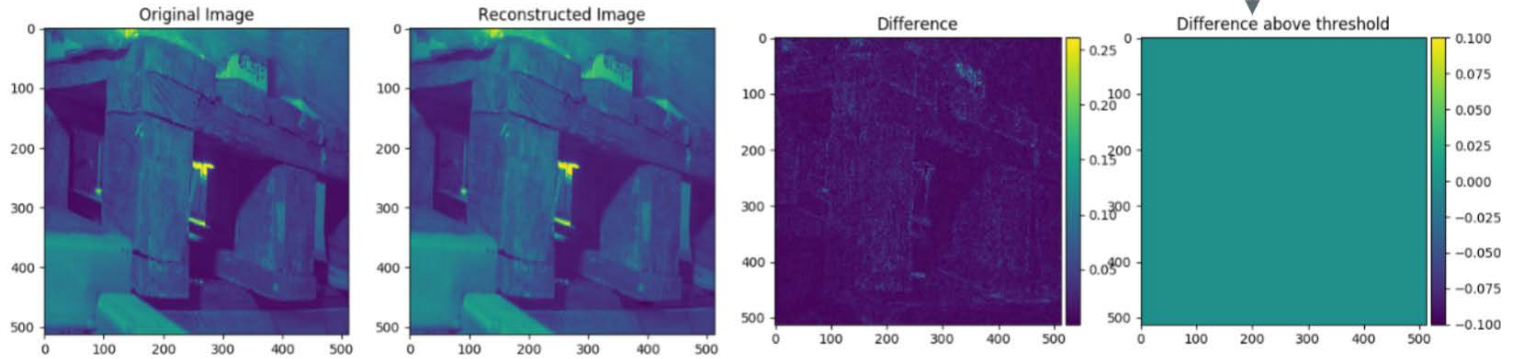


# AUTOENCODER RECONSTRUCTION ERROR EXAMPLE FOR HEALTHY AND FAULTY PALLET

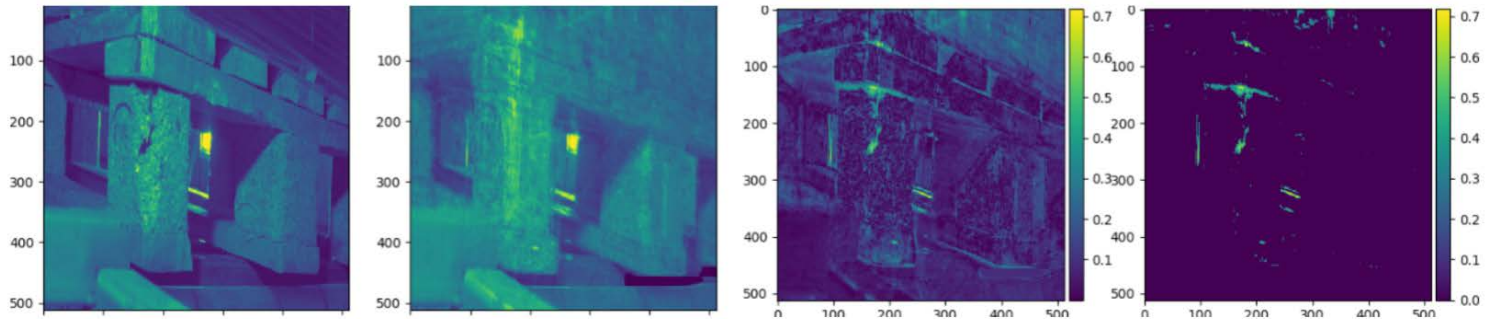
No reconstruction error was above the threshold



Healthy pallet:



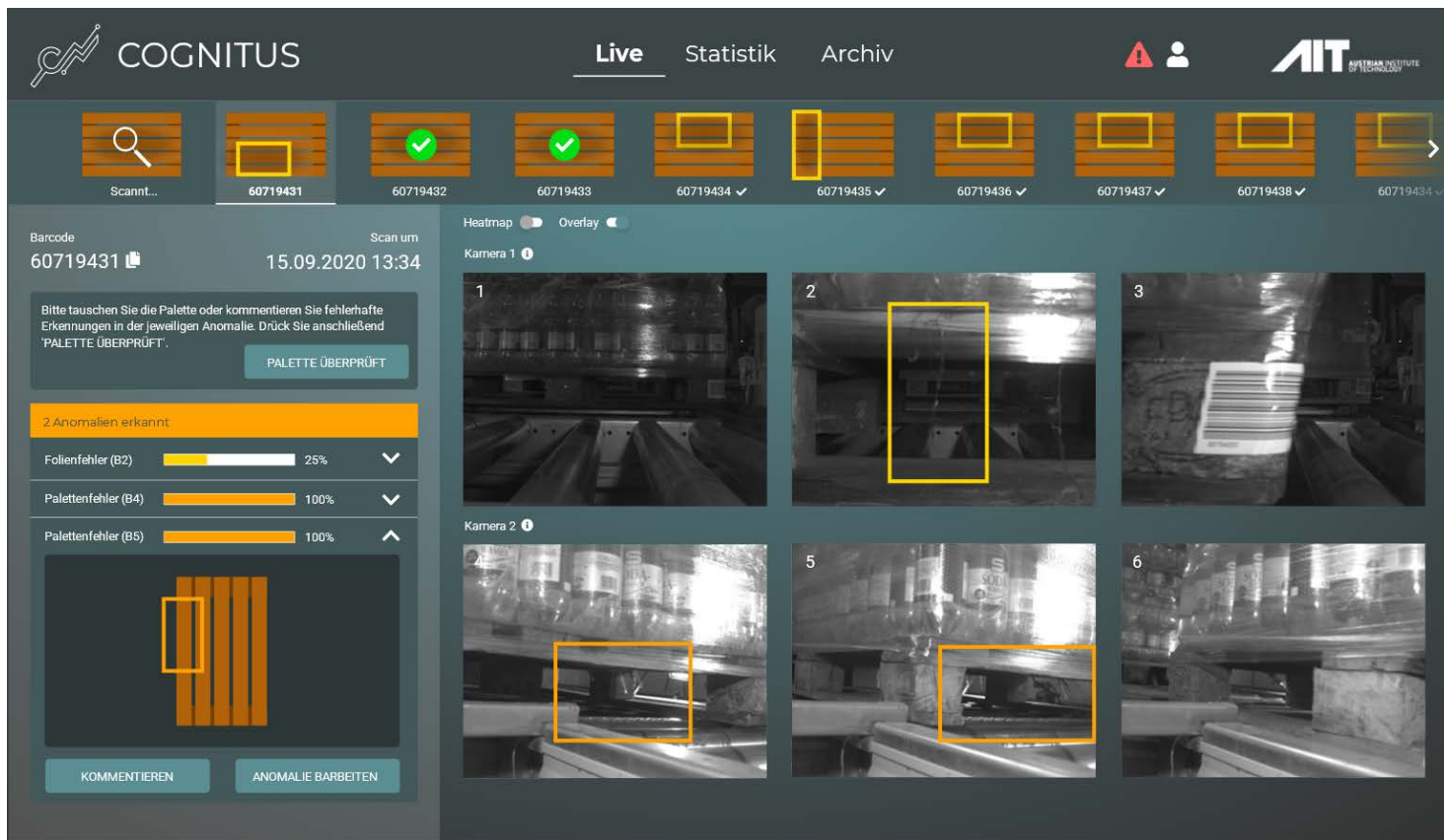
Faulty pallet:




## TRAINING & EVALUATION

- 3220 pallet images (of 560 different pallets) were used for training, validation, and testing (split 70%, 15%, 15%)
- recall performance of 0.857 but only low precision of 0.077
- subsequent fuzzy control system applied on the model increased the model precision to 0.782

# USER INTERFACE – DASHBOARD



**COGNITUS** Live Statistik Archiv ⚠️ 👤 

Scannt... 60719431 60719432 60719433 60719434 ✓ 60719435 ✓ 60719436 ✓ 60719437 ✓ 60719438 ✓ 60719439 ✓

Barcode: 60719431 📄 Scan um: 15.09.2020 13:34

Bitte tauschen Sie die Palette oder kommentieren Sie fehlerhafte Erkennungen in der jeweiligen Anomalie. Drück Sie anschließend "PALETTE ÜBERPRÜFT".

**PALETTE ÜBERPRÜFT**

2 Anomalien erkannt.

Folienfehler (B2) 📊 25% ⌵

Palettenfehler (B4) 📊 100% ⌵

Palettenfehler (B5) 📊 100% ⌶

**KOMMENTIEREN** **ANOMALIE BARBETEN**

Heatmap  Overlay





Kamera 1 📷

1 2 3

Kamera 2 📷

4 5 6

# USER INTERFACE – SEARCH

Live Statistik Archiv

**Suche** **Resultate**

Barcode:









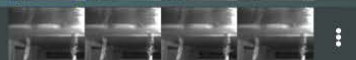






Von:  ▼

Bis:  ▼

Falsch erkannt

Folienfehler

Palettenfehler

Datum	Barcode	Fehlertyp	Anomalie korrigiert	Übersicht	Kameras
31.12.2020 12:00	60719430 	Folienfehler	Nein		
31.12.2020 11:00	60719430 	Folienfehler	Nein		
31.12.2020 10:00	60719430 	Folienfehler	Nein		
31.12.2020 9:00	60719430 	Folienfehler	Nein		
31.12.2020 8:00	60719430 	Folienfehler	Nein		

# DANKE!



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