# Real AI Applications in Manufacturing April 19, 2021

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### **The Four Industrial Revolutions**







Digital Innovation HUB UNIVERSITY OF EASTERN FINLAND















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- **Nearables** ensure the availability and delivery of digital services through the nearby smart surrounding.
- They provide the required services to the users without using gadgets or wearables.
- Instead, the intelligent and ambient environment offers the necessary/desired services to the users.















Dimension measurement of construction elements

# Dimension measurement of construction elements



# Automatic measurement of construction element dimensions

- Epipolar geometry
- 1 laser + 4 cameras







### **Research on paper surface**



STORA ENSO RESEARCH



# Paper roughness measurement using machine vision



LWC paper of different roughness

### Results

Correlation between industry standard Bendtsen measurement and the developed new machine vision method



## Classification of oven tiles



Classificaton of wood pieces based on knot classes

### **Classification of defects on wood**

Sound	Decayed	Dry	Encased	Leaf	Horn	$\operatorname{Edge}$
knot	knot	knot	knot	knot	$\operatorname{knot}$	knot
Chefe		0	C			
0	0	0	0	A		Jak .
13		0		1		

Measurement of welfare of plants (cucumber)



# Monitoring of cucumber using spectral imaging

Kuivatus, otos5 20.7.2000, klo 15.10-15.26, stressattu











### Scanning setup/workstation

### Introduction

- The aim was to implement a Machine vision framework that takes images of wood and then identify the defects and mark those defects so that those wood are separated from non defective wood.
- Our method successfully detected and classified the defects.
- The detection accuracy of our algorithm is 99 percent.
- The average accuracy for each class is 86 percent.

### **Operations:**

- Recognition of defects
- Segmentation of defects
- Classification and localization of defects
- Calculation of number of defects
- Applicable for
  - Wood
  - Metal
  - Glass
  - Plastic
  - Etc.

### Classification

### **Object Detection**



Semantic Segmentation



### Results













## Scanning setup/workstation

- Multiple depth cameras and Machine vision camera are used to take RGB and depth images from around the objects.
- The setup also includes multiple LED lights to make different illumination.
- The images are then passed to the algorithm and processed to make a 3D model of the object
- In our current solution we used only image-based data to make 3d models of very challenging objects that has matt color and are without texture.
- Our method produced very accurate and near perfect 3d reconstruction of these challenging texture less objects.
- More sophisticated sensors like Lasers and structured light scanners can be used to integrate to our current setup to improve the reconstruction results.



### Scanning setup/workstation

## Some images from different views









## Results









## Recognition of printed text on packages

### Intelligent handling of pharmaceutical packages

- Intelligent handling of pharmaceutical packaging
  - How to automate the task that now requires human vision?
  - Difficulty of recognizing texts made with different printing methods from distorted surfaces
     UEF uses a companys image for development work
     Noticed insufficient resolution of the images for OCR, company informed
- Novel text binarization method has been developed
  - A research article has been made on the method
  - Method presented at the Electronic Imaging 2021 Conference in USA
- Survey article now in progress of research on the packaging texts recognition
- The new information from the survey article will be utilized in the method development of the next stage

### **Binarized, Laser Printed Texts**



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Industrial Machine Vision /DigiCenterNS, Jarmo Koponen

### **Binarized**, Stamped Texts



Industrial Machine Vision /DigiCenterNS, Jarmo Koponen

# Conclusion

- We don't have yet general AI
- However, AI is developing rapidly
  - Conversational AI, Reasoning, Chatbots
  - Machine vision
    - 3D imaging
    - Spectral imaging
- Al can be used to solve an increasing number of difficult problems
- VR, AR, XR
  - XR Hub North Savo
- Digital twins















# Thank You!







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