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Bringing Innovative Solutions to Life

Machine vision-based automated leather defect inspection and grading

Tariq Mahmood Khan, Ph.D.(CEO)
School of Computer Science and Engineering, UNSW, Sydney
mail: tariq.khan@unsw.edu.au

Syed Saud Naqvi, Ph.D.
Managing Director
Visual Computing Technologies

Visual Computing Technologies

New Zealand Leather & Shoe Research Association Inc. (LASRA®)

Agenda

- Artificial Intelligence (AI) vs Manual Process
- Visual Inspection in Manufacturing
- Machine Vision Challenge
- How Machine Vision Works?
- Impact on Leather Industry
- AI Based Solutions for Leather Processing
- Bigger Picture

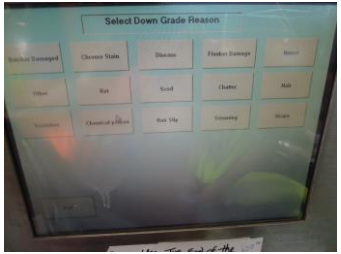
ARTIFICIAL INTELLIGENCE (AI) VS MANUAL PROCESS

Manual vs AI Powered Defect Analysis

Manual Inspection

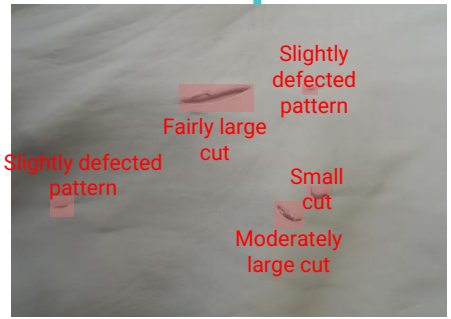
- √ Human bias
- √ Slow and costly

Grade 3



AI Inspection

- √ Surpass human performance
- √ Time and cost saving



VISUAL INSPECTION IN MANUFACTURING

Visual Inspection in Manufacturing

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Targets

Defects

Automobile parts

Materia parts
Resin parts
Fabric

Scratch
Crack
Dirt
Dent
Burr / Chip

Electronic parts

PCB
Electrobnic parts
Electrical component
Panel

Scratch
Crack
Burr / Chip

Building materials

Wood board
Sash
Metal fitting
Tile

Scratch
Crack
Dirt
Dent
Surface Pattern

Nonferrous metals

Wire, Cable
Aluminum
Stainless
Steel

Scratch
Crack
Dirt
Dent

Raw materials

Chemical fiber
Rubber
Glass
Paper, Pulp

Scratch
Crack
Dirt
Dent

Food

Processed Food
Beverage

Foreign object
Wrong print
Leak

Medical

Medicine

Foreign object
Wrong print
Crack

Others

Materia parts
Resin parts

Defect classification
Shape check

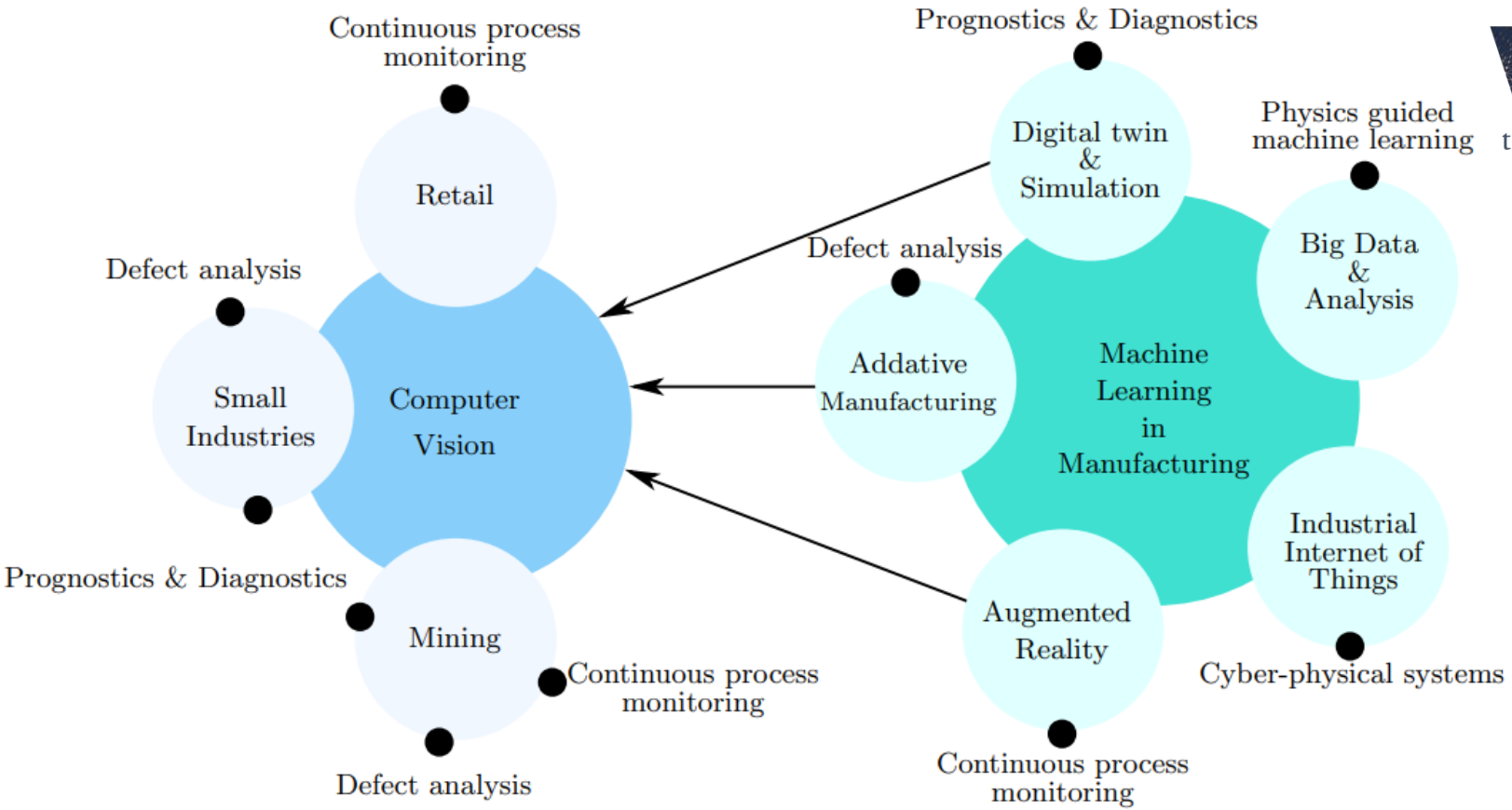
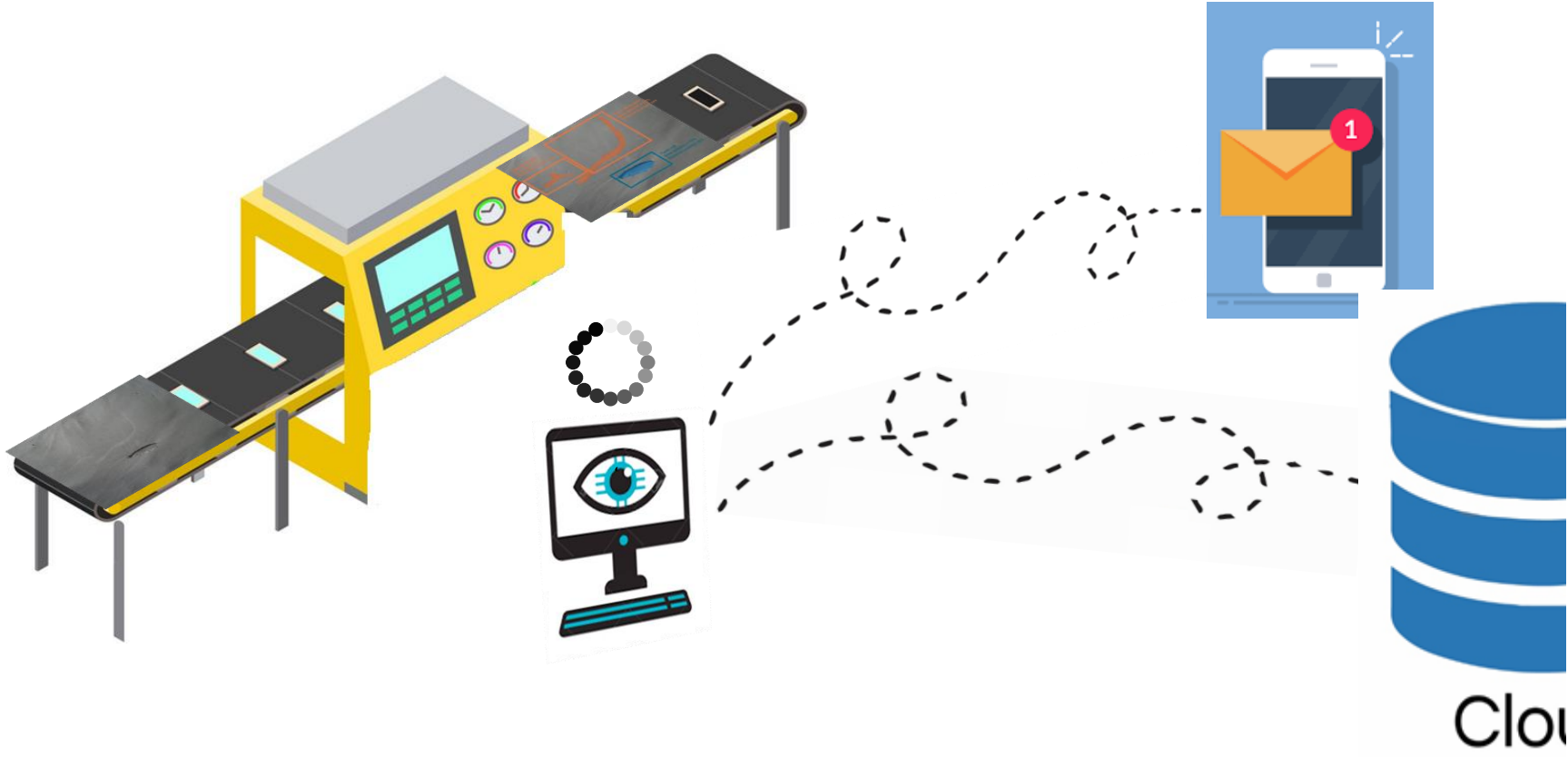


Figure 1: High-impact machine learning application areas in industry and the role of computer vision. This figure also depicts how computer vision-based approaches are assisting key Australian industries like mining, retail, and small industries like meat, paper, and leather.

Machine Vision Pipeline for Leather Inspection



Recommendation System

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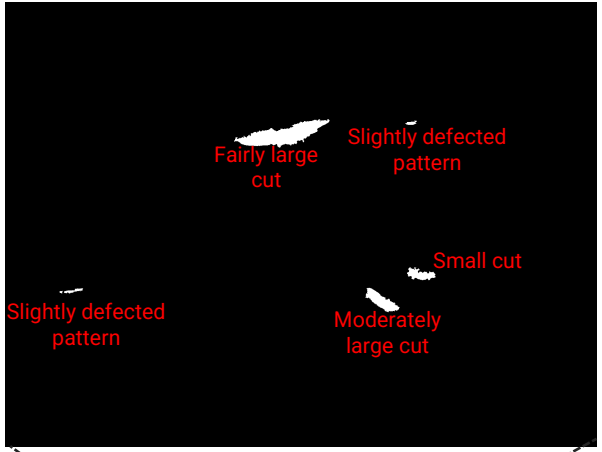
MACHINE VISION CHALLENGE

Quality Grading Detailed Process

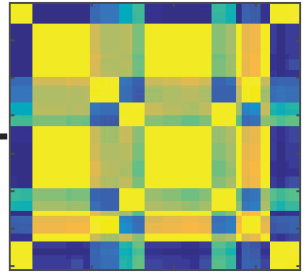


Semantic Segmentation

Image Analysis

Multiple Graders Information

Feature matrix



- Shape features
- Texture features
- Location features
- Contextual features

⋮

Multiclass Classification

Grade 1: 1.0%
Grade 2: 9.6%
Grade 3: 86.4%
Grade 4: 3.0%

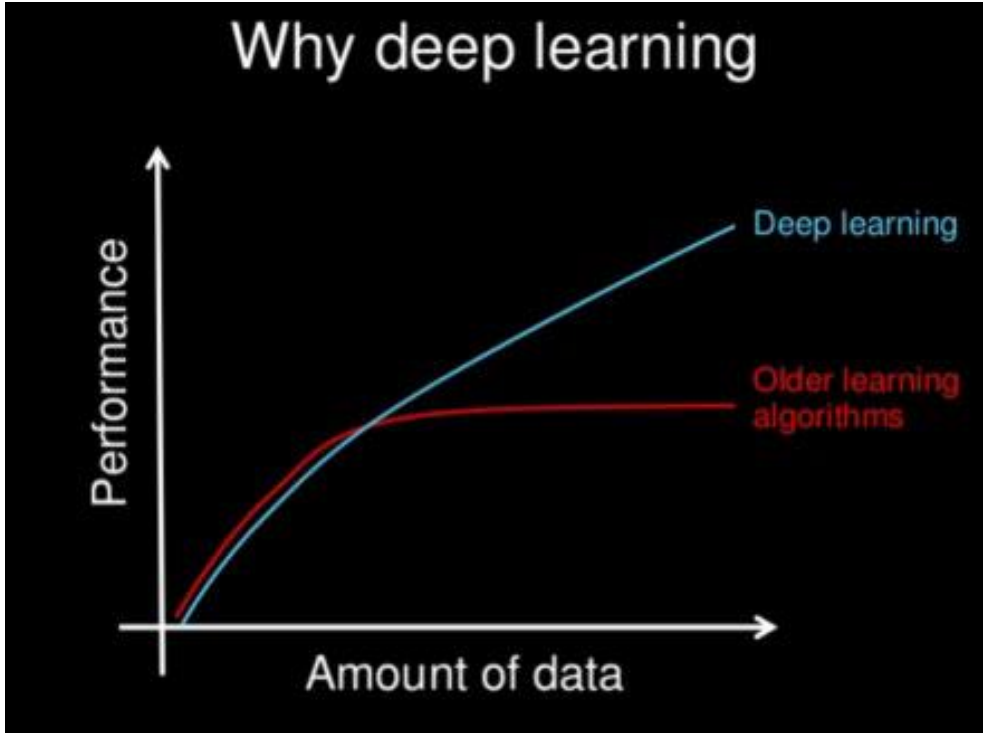
Defects Scale (Large to Tiny)

Tiny Defect

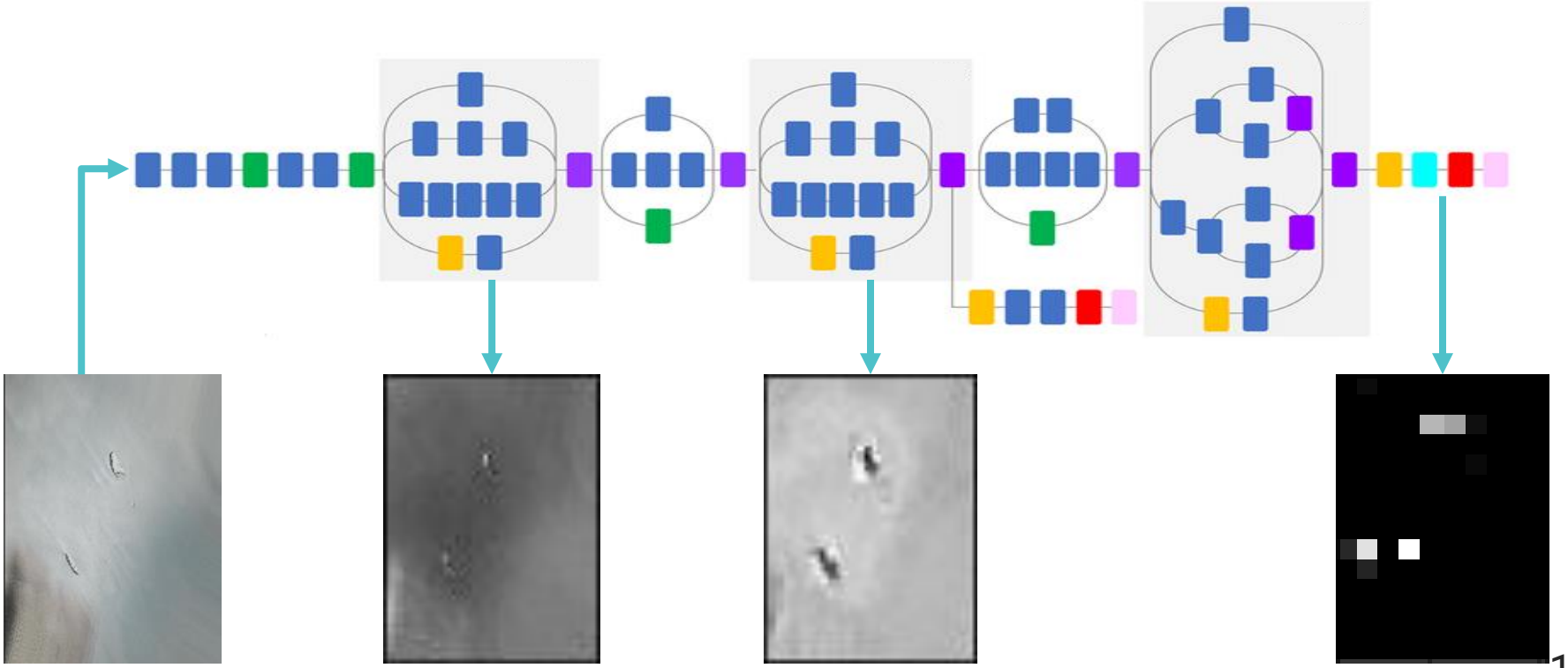
Large Defect

HOW MACHINE VISION WORKS?

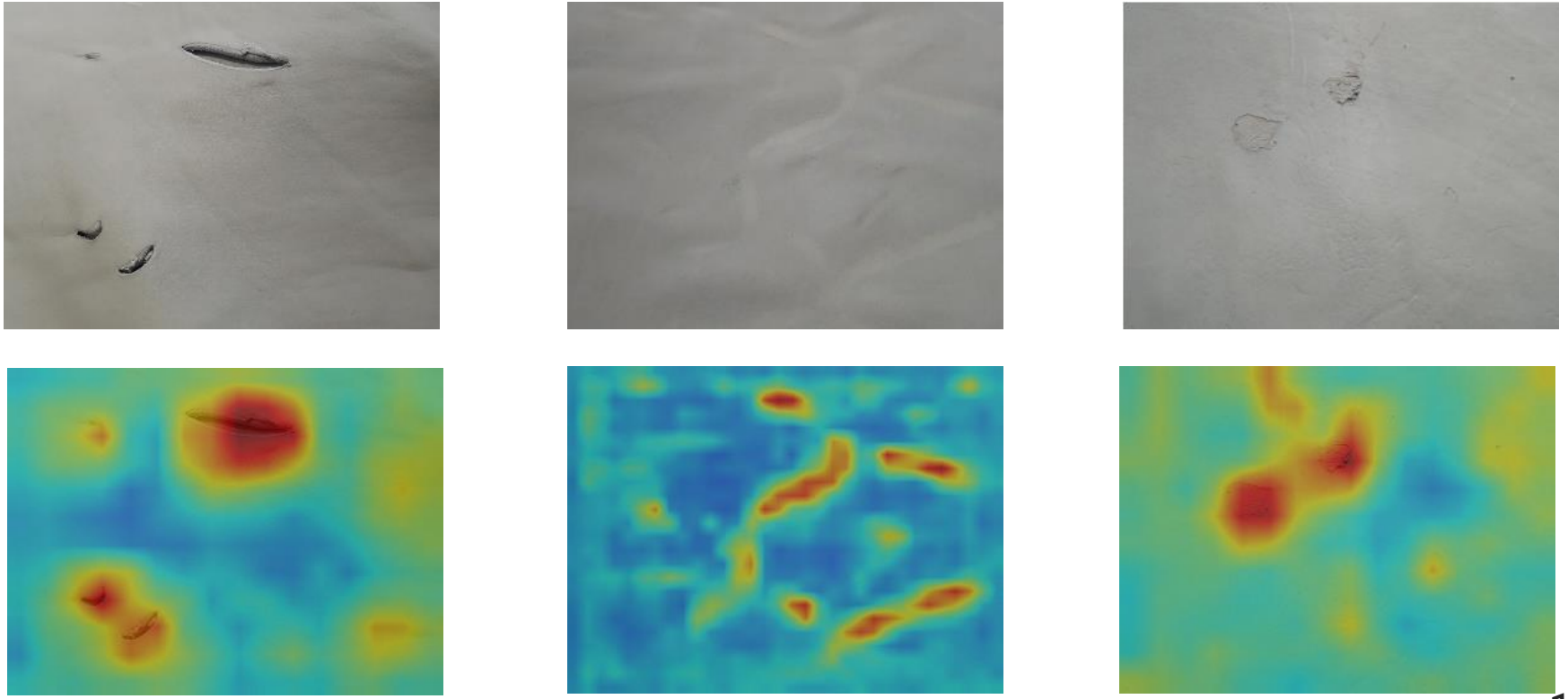
Deep Learning as a Natural Solution



AI Model Learning to Recognize Defects



What AI Model Sees



IMPACT

Competitive Advantage

Competitors	Remarks
Hyperspectral imaging solution - Intelligence Recognition Industry Service Research Center	• Cost • Computationally expensive • Not end-to-end
Mindhive – Model V	Image based

Our competitive advantage

- Large image sizes – capture features at multiple scales
- Novel architectures to support low computational requirements
- Online leather grading

Publication Output

Title	Venue	Status
1. On the Application of Automated Machine Vision for Leather Defect Inspection and Grading: A Survey	IEEE Access	Published, in 2020
2. Ensemble Convolutional Neural Networks with Knowledge Transfer for Leather Defect Classification in Industrial Settings	IEEE Access	Published, in 2020
3. Putting Current State of the art Object Detectors to the Test: Towards Industry Applicable Leather Surface Defect Detection	DICTA	Published in 2021
4. Learning to recognize irregular features on leather surfaces	Journal of the American Leather Chemists Association	Published in 2021

5. An Ensemble of Fine-Tuned Deep Learning Networks for Wet-Blue Leather Segmentation	Journal of the American Leather Chemists Association	Published in 2022
6. Trainable Guided Attention Based Robust Leather Defect Detection		To be submitted

AI BASED SOLUTIONS FOR LEATHER PROCESSING

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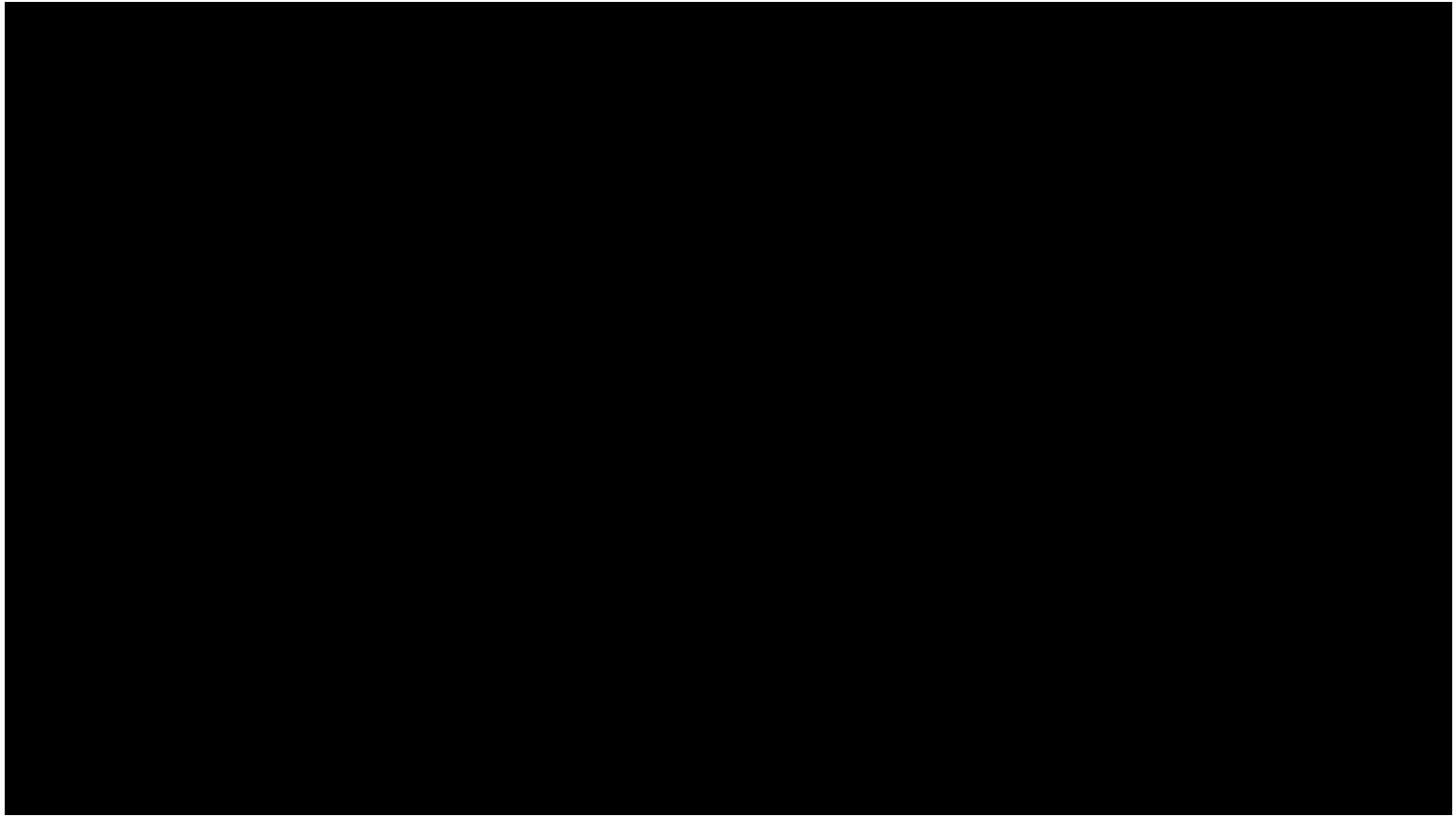
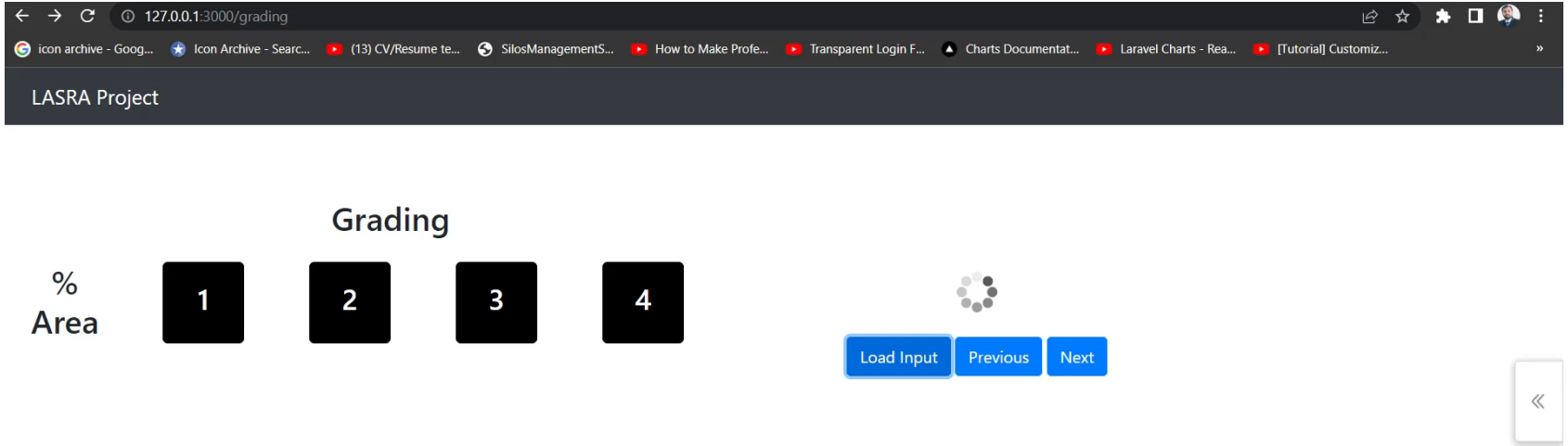
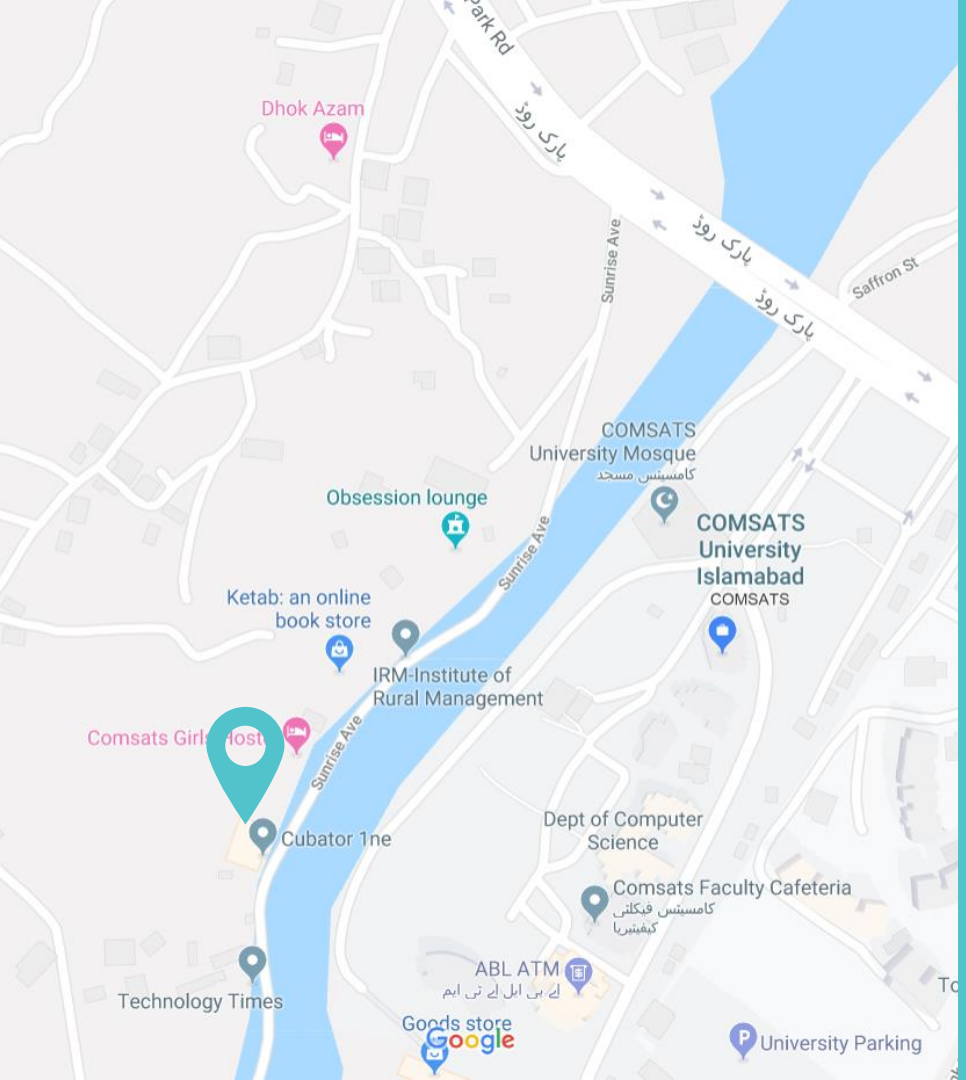
VIDEO INPUT BASED ANALYSIS



HIDE BASED GRADING





CONTACT US

Visual Computing Technologies

Suite 109, Cubator 1ne, Park Road, Chak Shahzad, Islamabad, Pakistan

+92 (0)336 – 886 - 4382

info@vc-technologies.com

www.vc-technologies.com