

Actual Life Applications of AI

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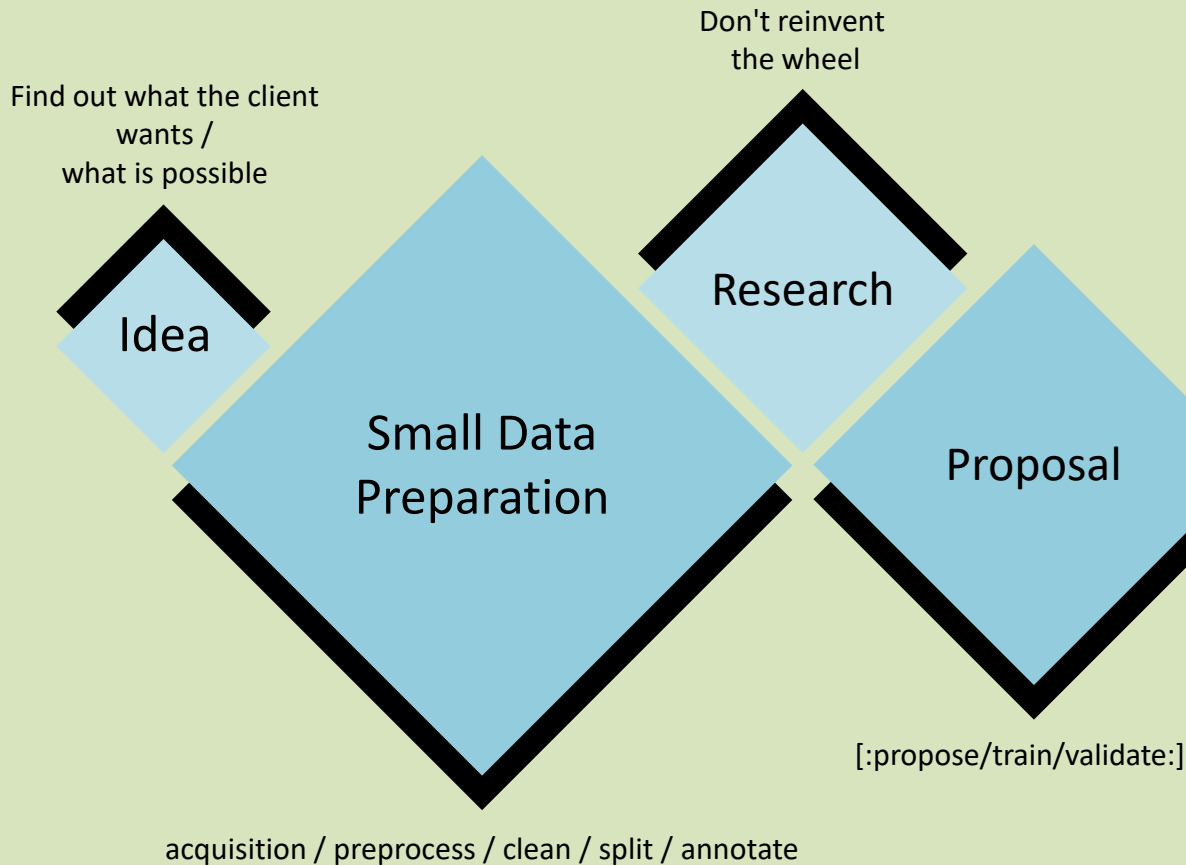
- 28 persons
- CZ & European industrial projects
- CZ & European grants

- teaching at universities
- PhD students

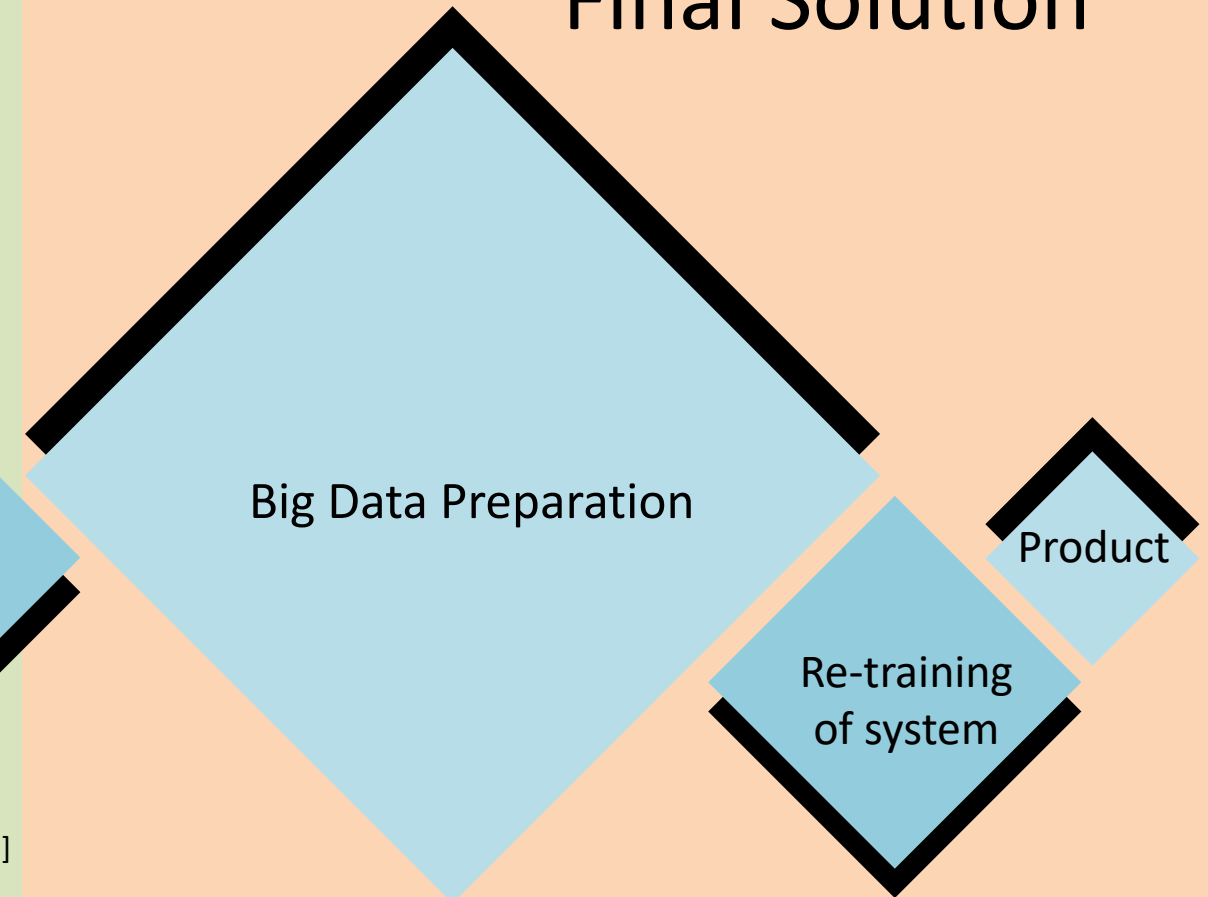


Experience with AI projects

Proof-of-Concept



Final Solution



Selected Projects

1

Industry



3

Healthcare



2

Biology



4

Cultural Heritage



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Selected Projects

1

Industry



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Biology

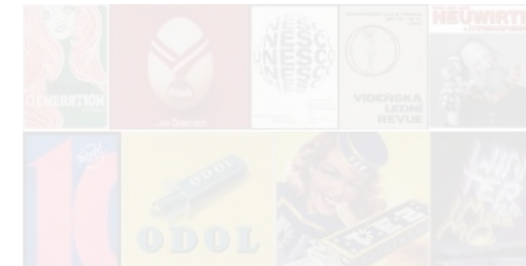


4

Cultural Heritage



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System for Automatic Size and Type Control of Car Rims



Car and wheel detection

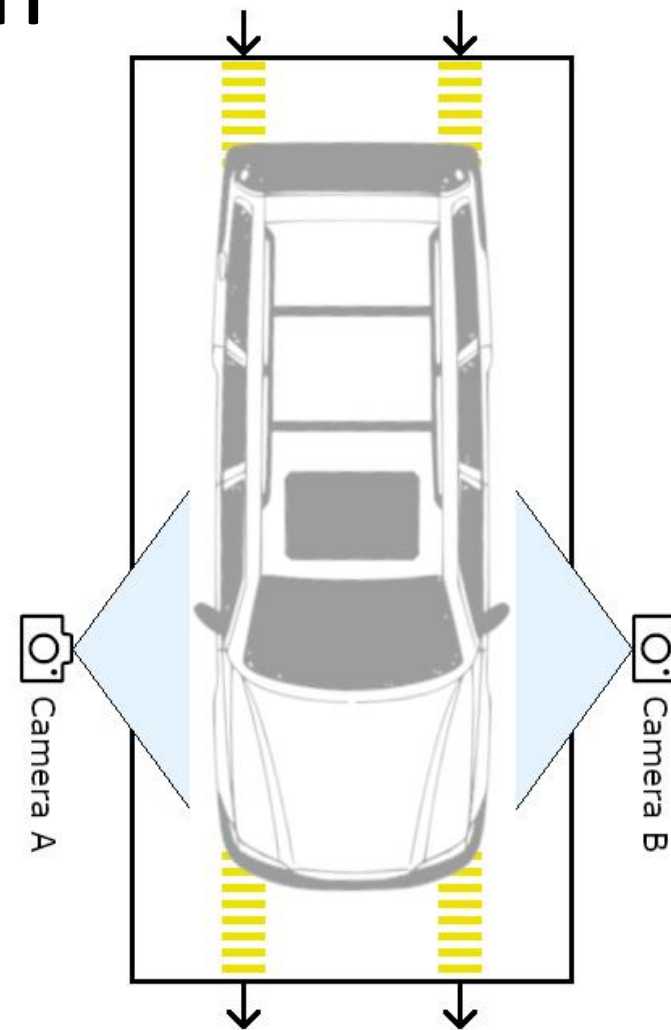
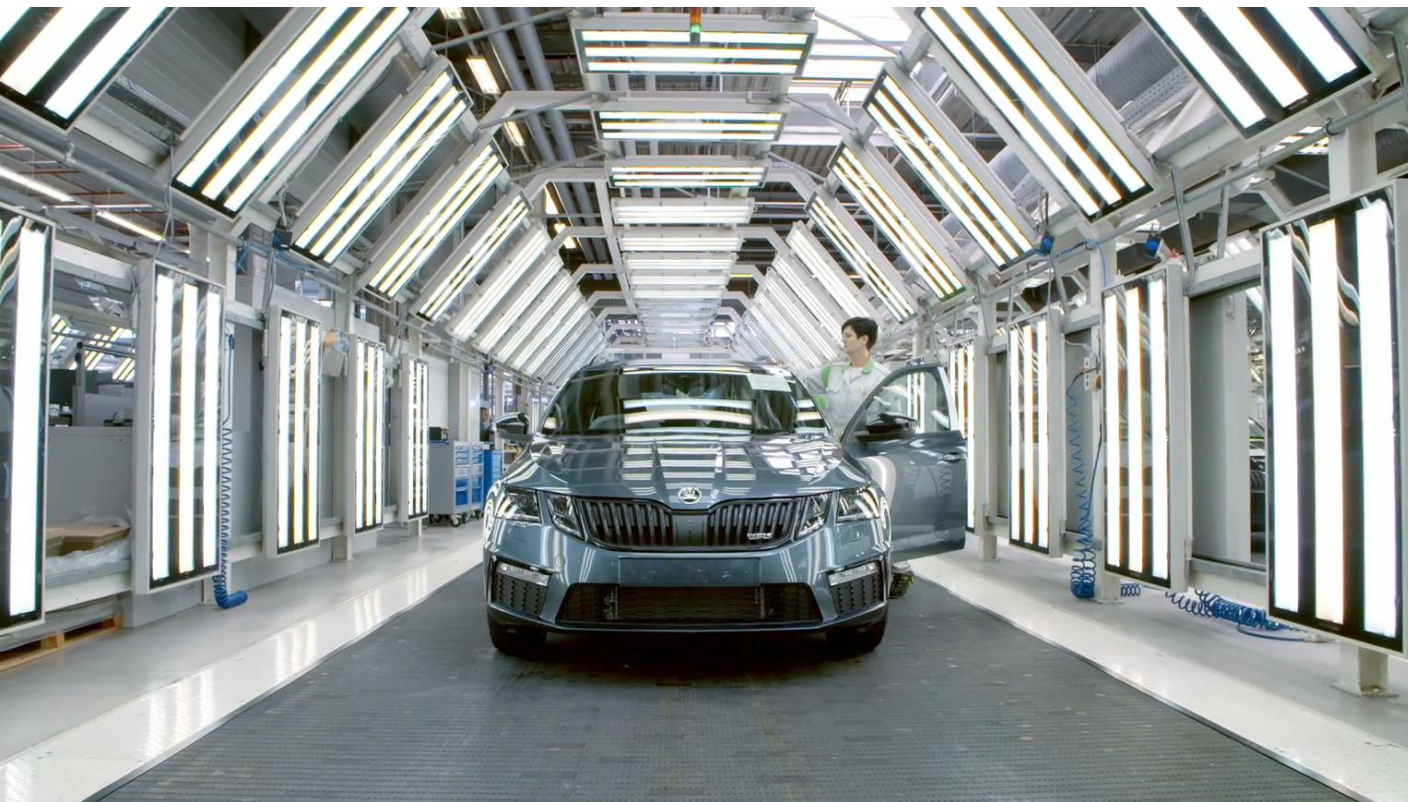
Wheel classification

Wheel size estimation

Wheels comparison



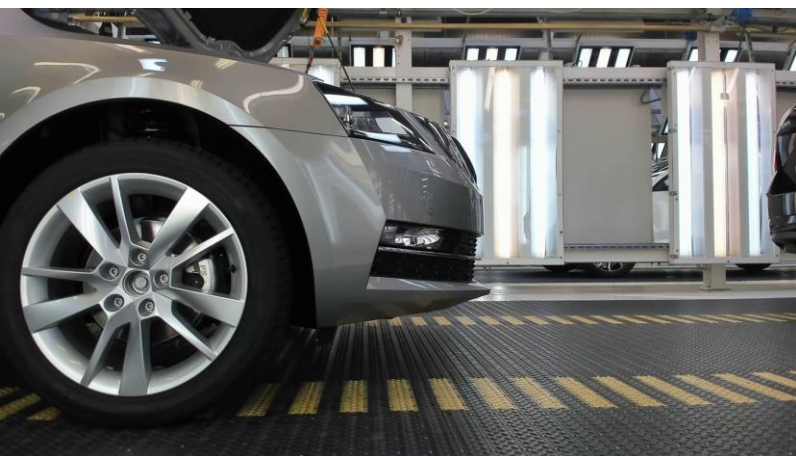
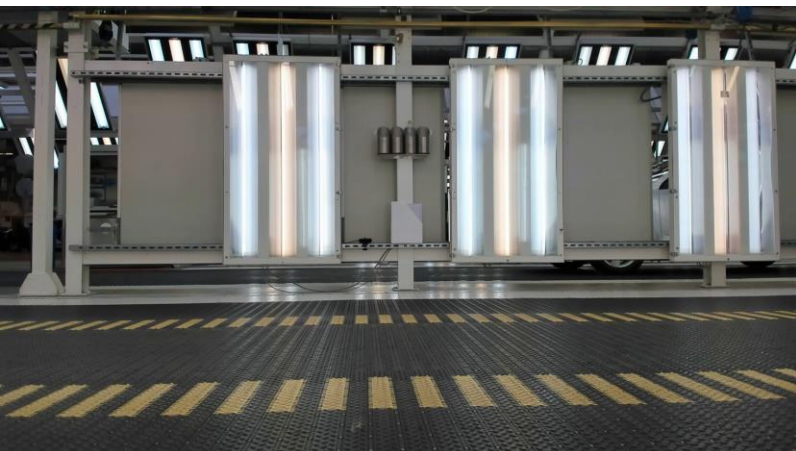
Scanning System



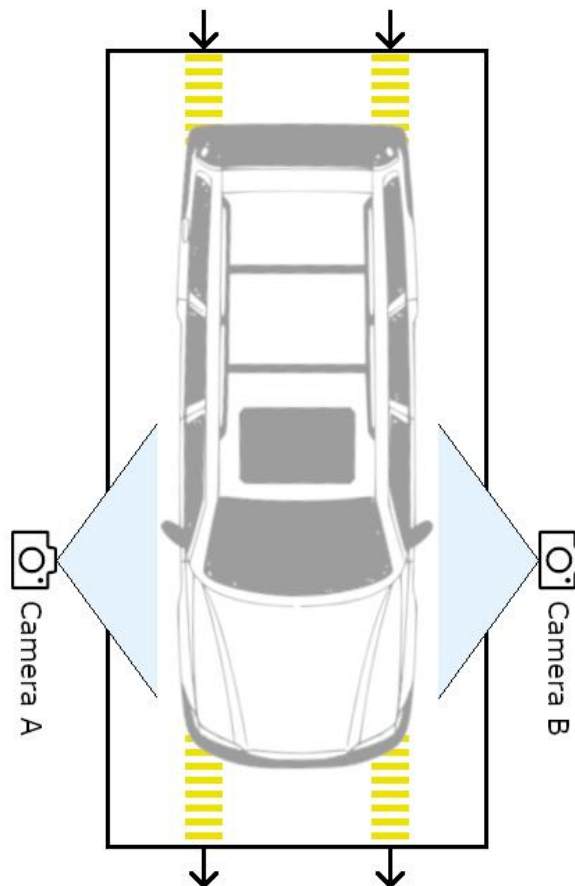
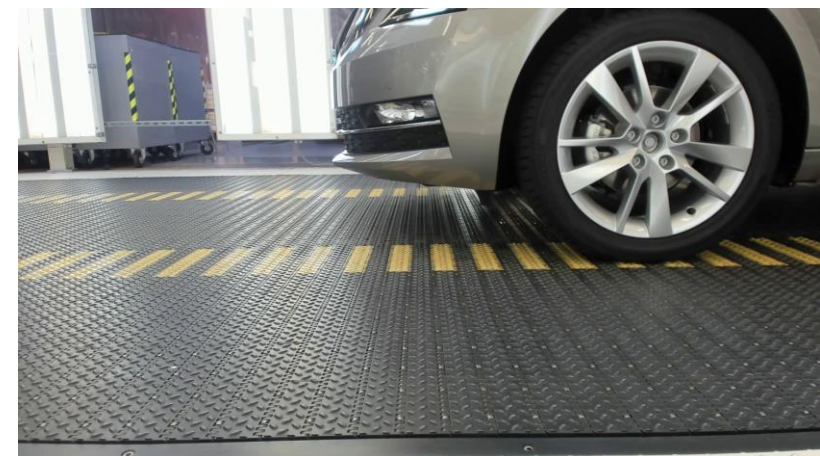
2x 1fps Full HD cameras

Scanning system

Camera A



Camera B



Data Collection

Normal brightness



Occlusions



High brightness

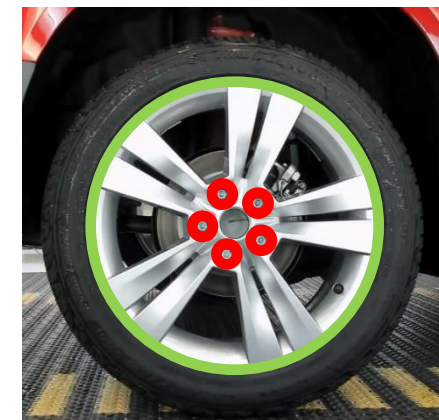


Scoters

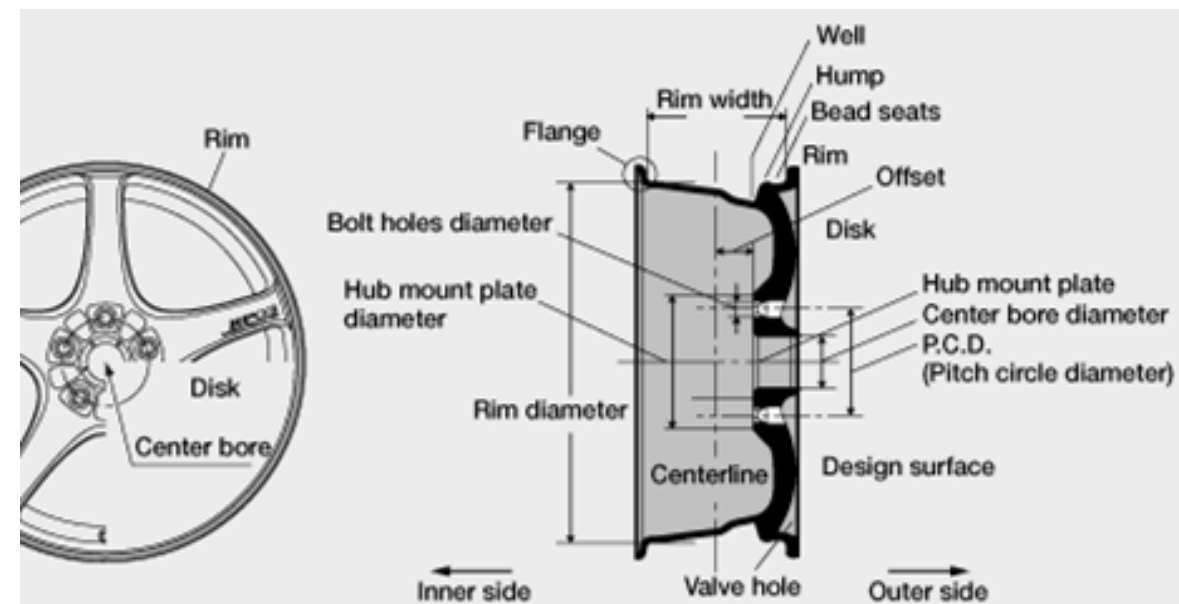


Detection - YOLOv5 & Hough Transform

- $\pm 7M$ parameters
- Transfer Learning on pretrained weight - MSCOCO
- Inference time circa 26ms



Class	Labels	Precision	Recall	mAP@.5
Wheel	182	0.983	0.97	0.993
Car	300	0.983	0.98	0.993
Bolt	475	1.000	0.998	0.995
Rim	95	0.984	1.000	0.995



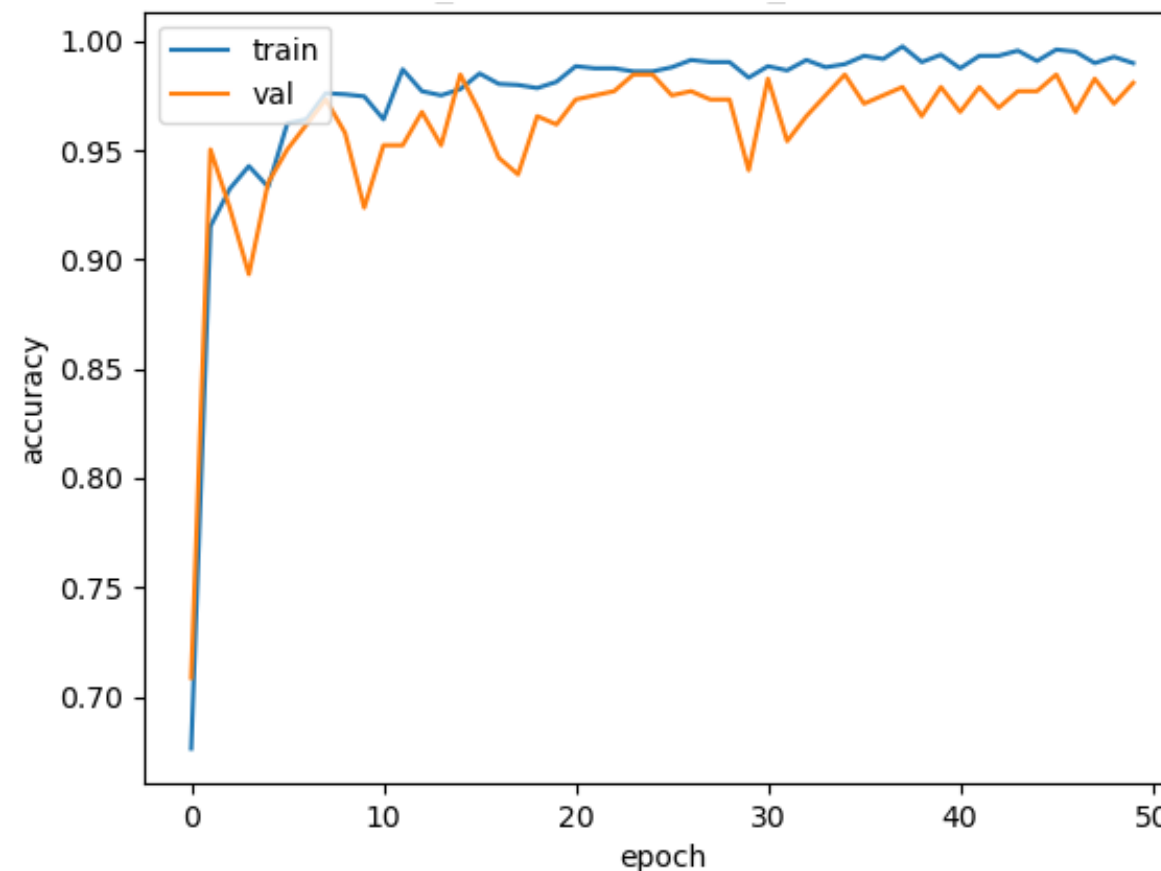
Classification - EfficientNet

31 classes of rims – 100 train, 25 validation and 25 test per class

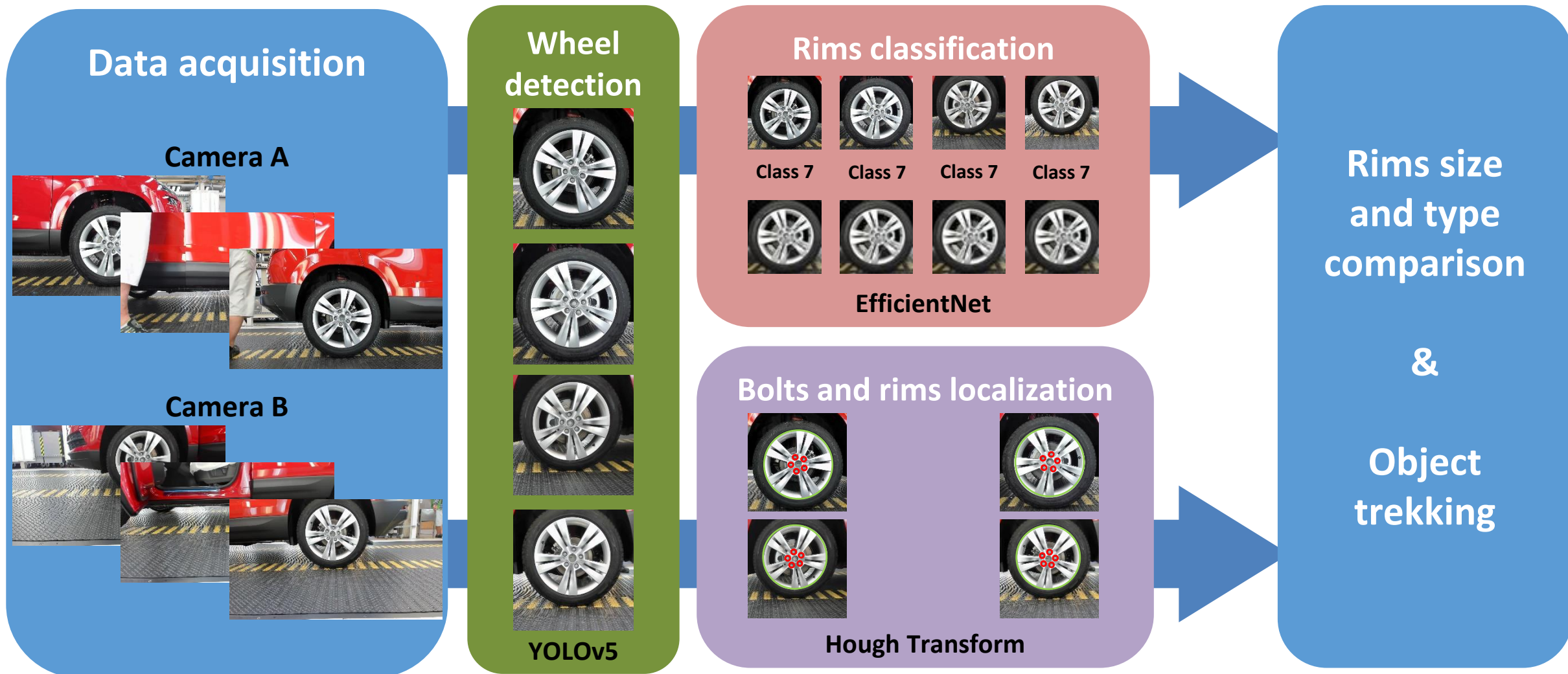
Augmentation



Accuracy on Test Set = **98.6%**



Our Final System



Prototype app

Detection visualisation

Hough parameters tuning

Size estimation testing

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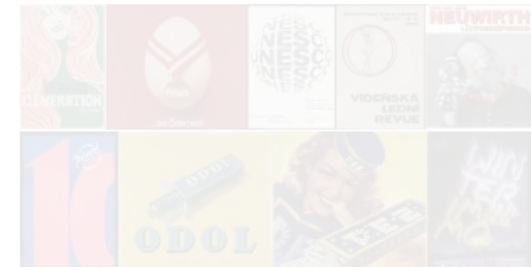


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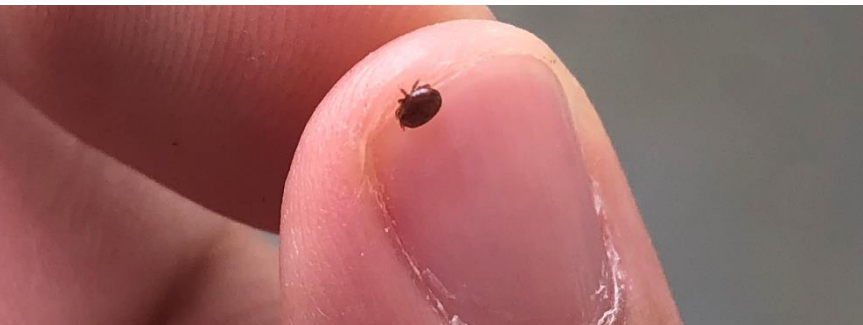
Cultural Heritage



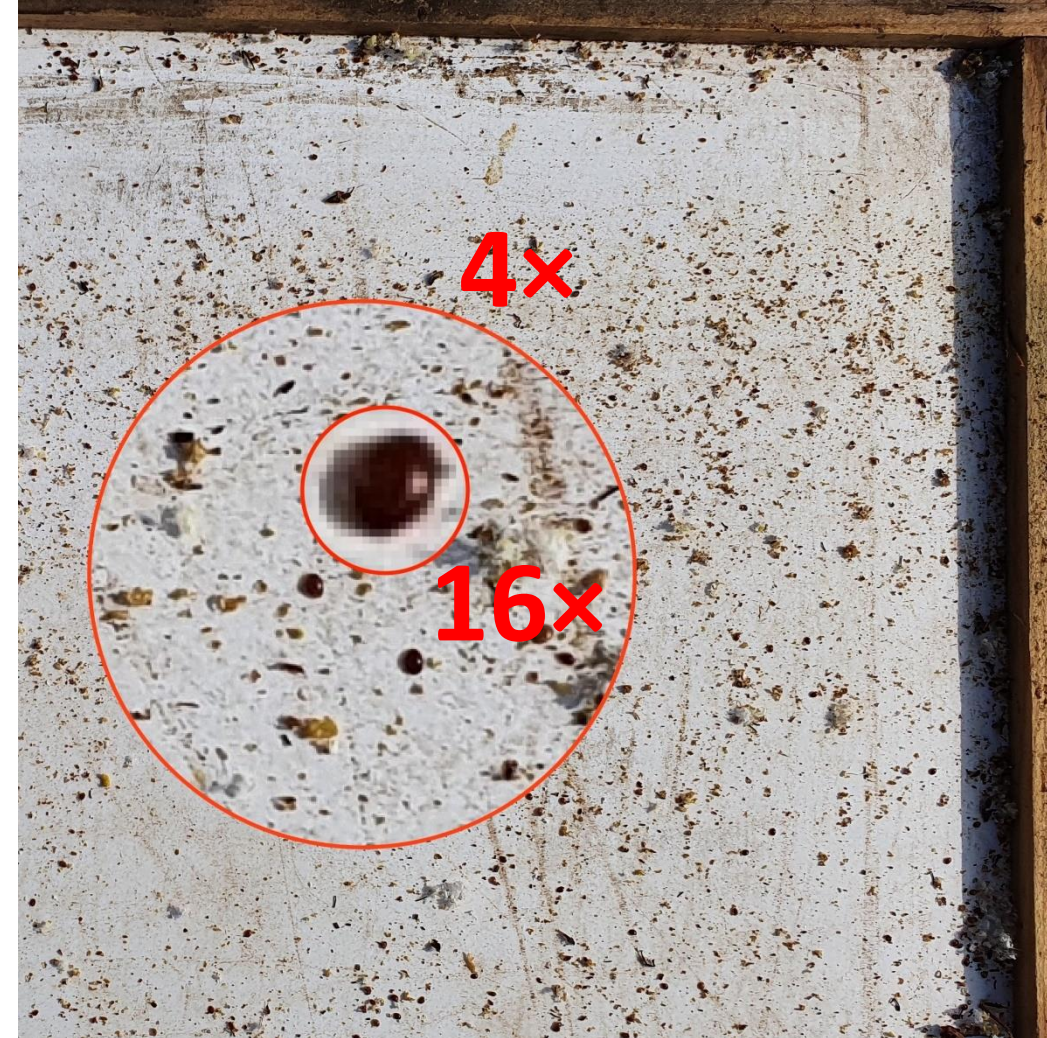
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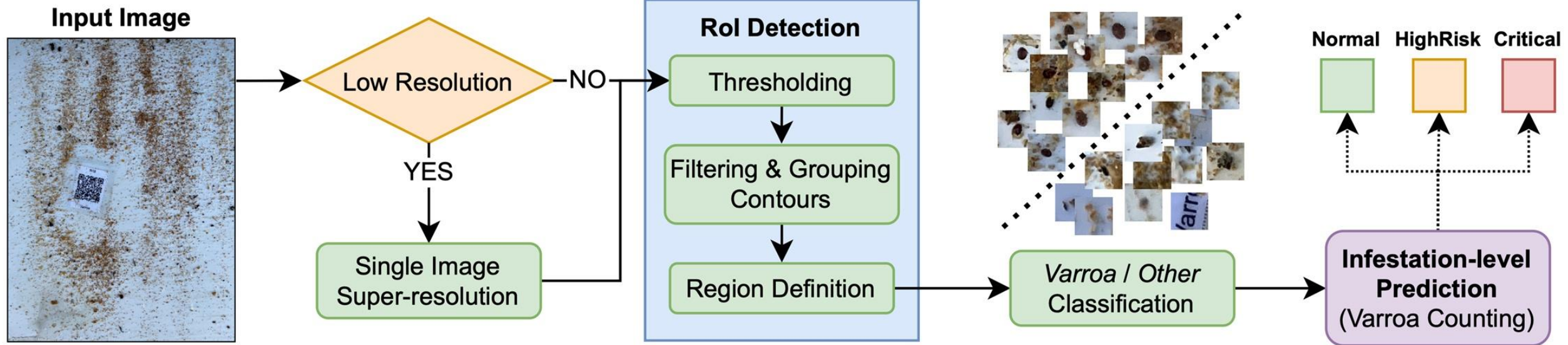
Monitoring of Varroa Infestation rate in Beehives



Fall-out board



Methodology



Pre-processing : Single Image Super-resolution



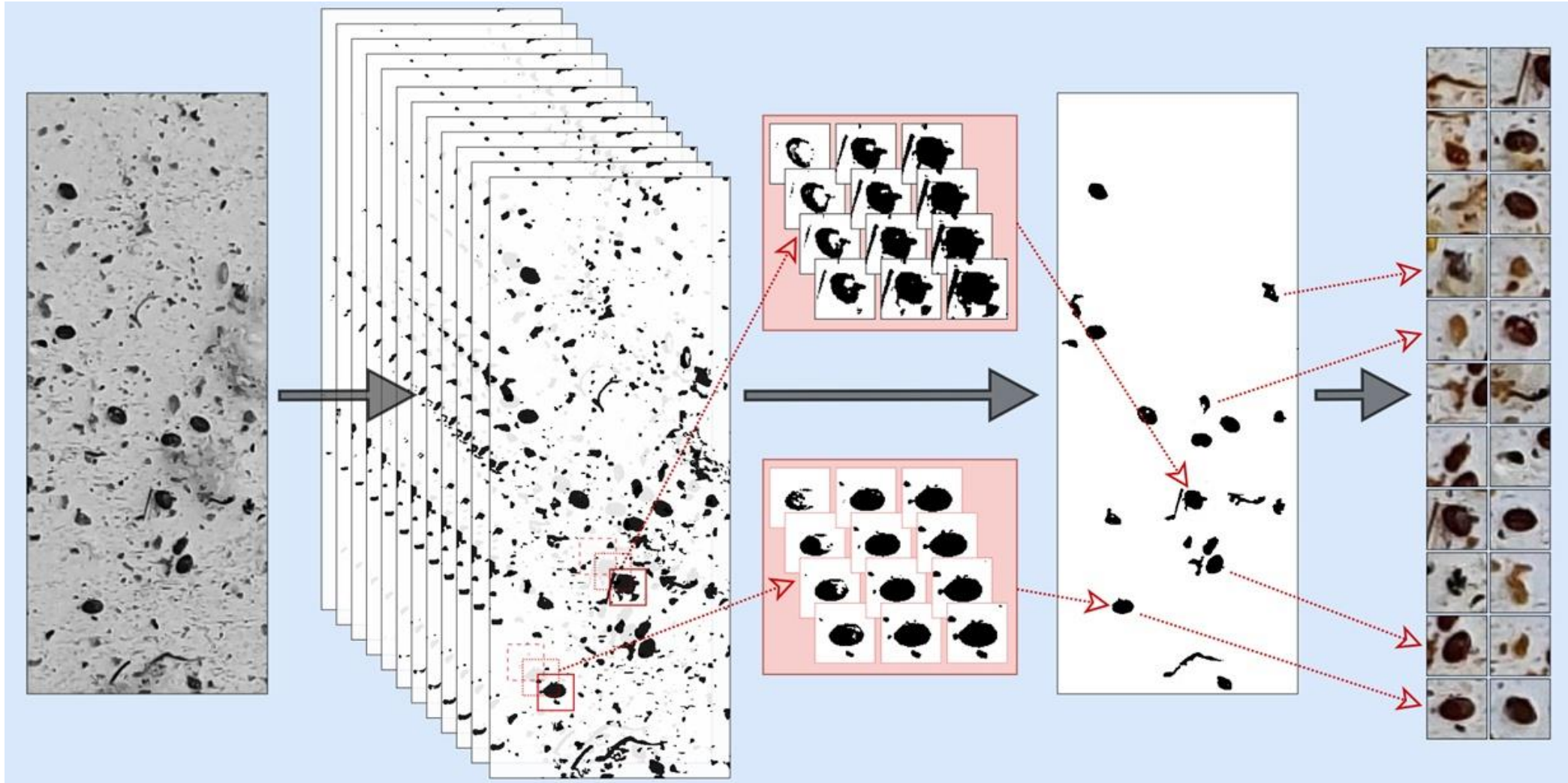
Original

x2

x4

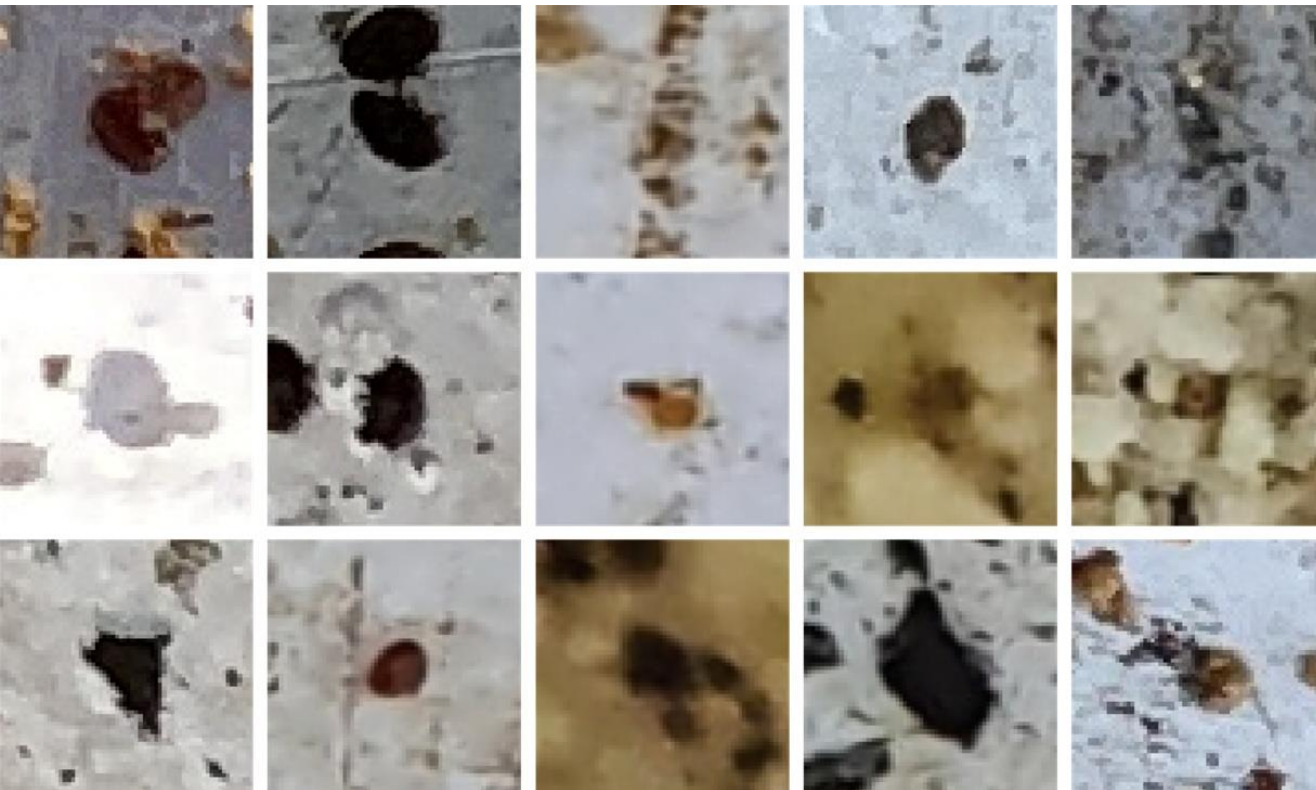
x8

RoI Detection



Classification – Our shallow CNN

- Standardly around 2000 Rols
 - In the autumn season up to 10000



VarroaNet

Layer	Out. Shape	Params
Conv2d	[6, 60, 60]	456
MaxPool2d	[6, 30, 30]	-
Conv2d	[12, 28, 28]	660
MaxPool2d	[12, 14, 14]	-
Conv2d	[12, 12, 12]	1,308
MaxPool2d	[12, 6, 6]	-
Linear	[100]	43,300
Linear	[50]	5,050
Linear	[2]	102

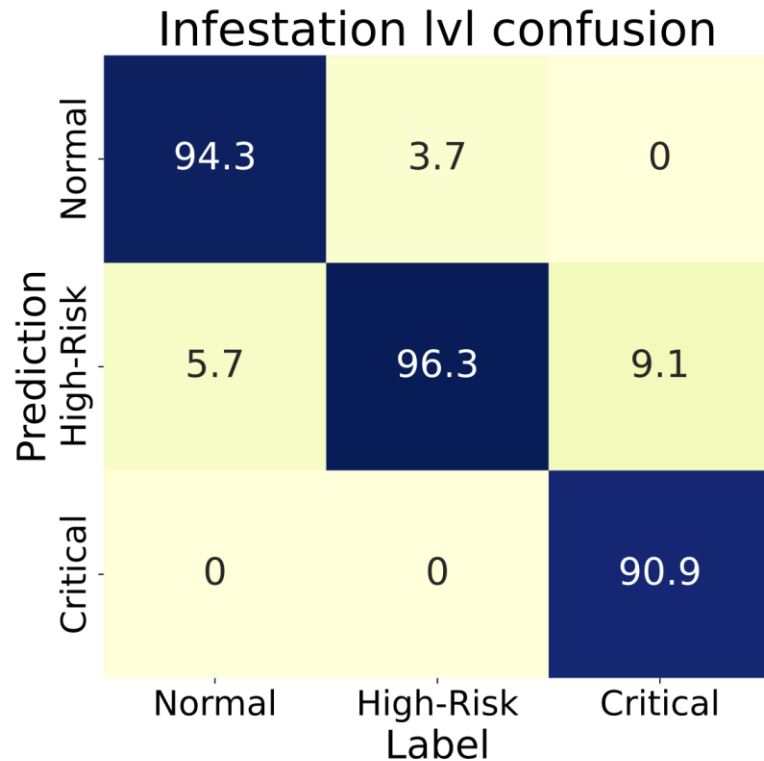
Classification – Our shallow CNN

Architecture	Sensitivity	Specificity	F1 ^m	Params
MobileNet-V3-S-0.75	98.3%	89.3%	89.3%	1.0M
SE-MnasNet-0.75	98.9%	88.5%	93.0%	1.6M
FBNetV3	98.8%	89.9%	93.3%	6.6M
VarroaNet	98.4%	90.5%	92.1%	0.1M

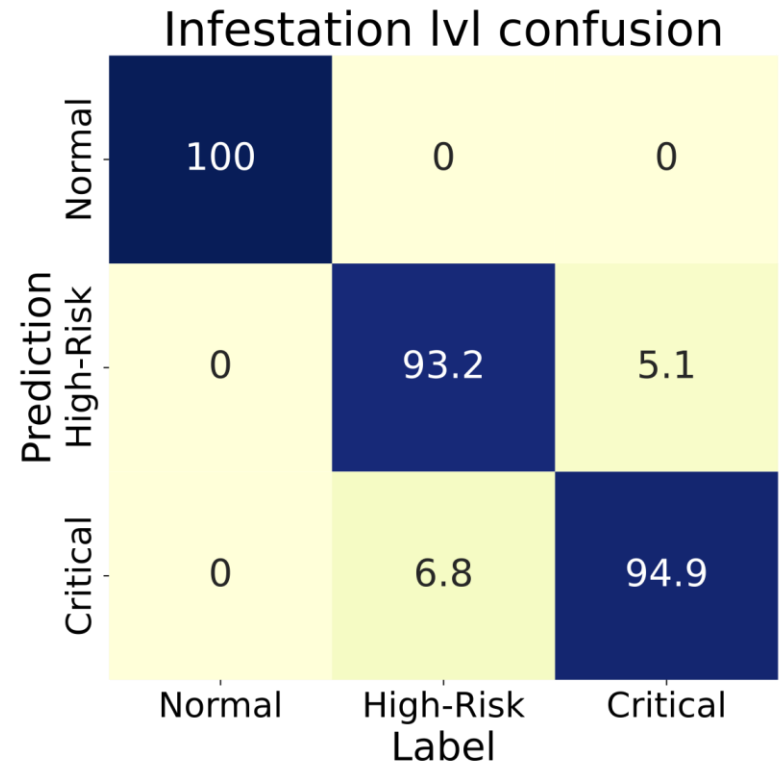
The proposed model complexity is up to $100 \times$ lower >> with a similar accuracy.

Results – Infestation level

Autumn Season



Winter Season



Many more Varroa mites fall in autumn than in winter.

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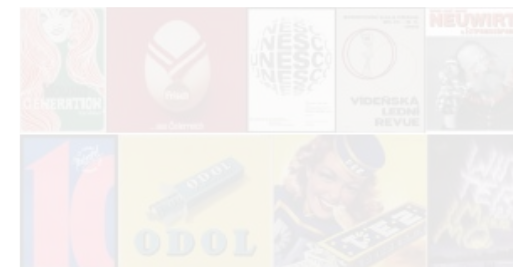


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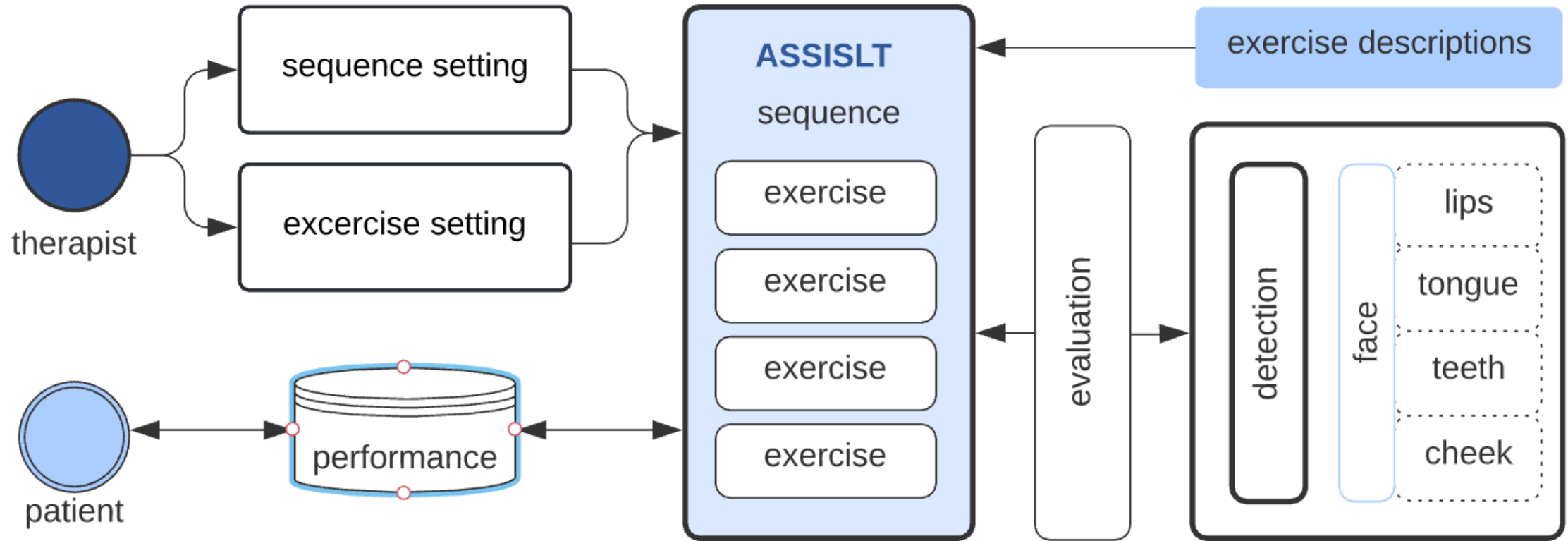


ASSISLT: Computer-aided speech therapy tool



First speech therapy application
No special hardware necessary

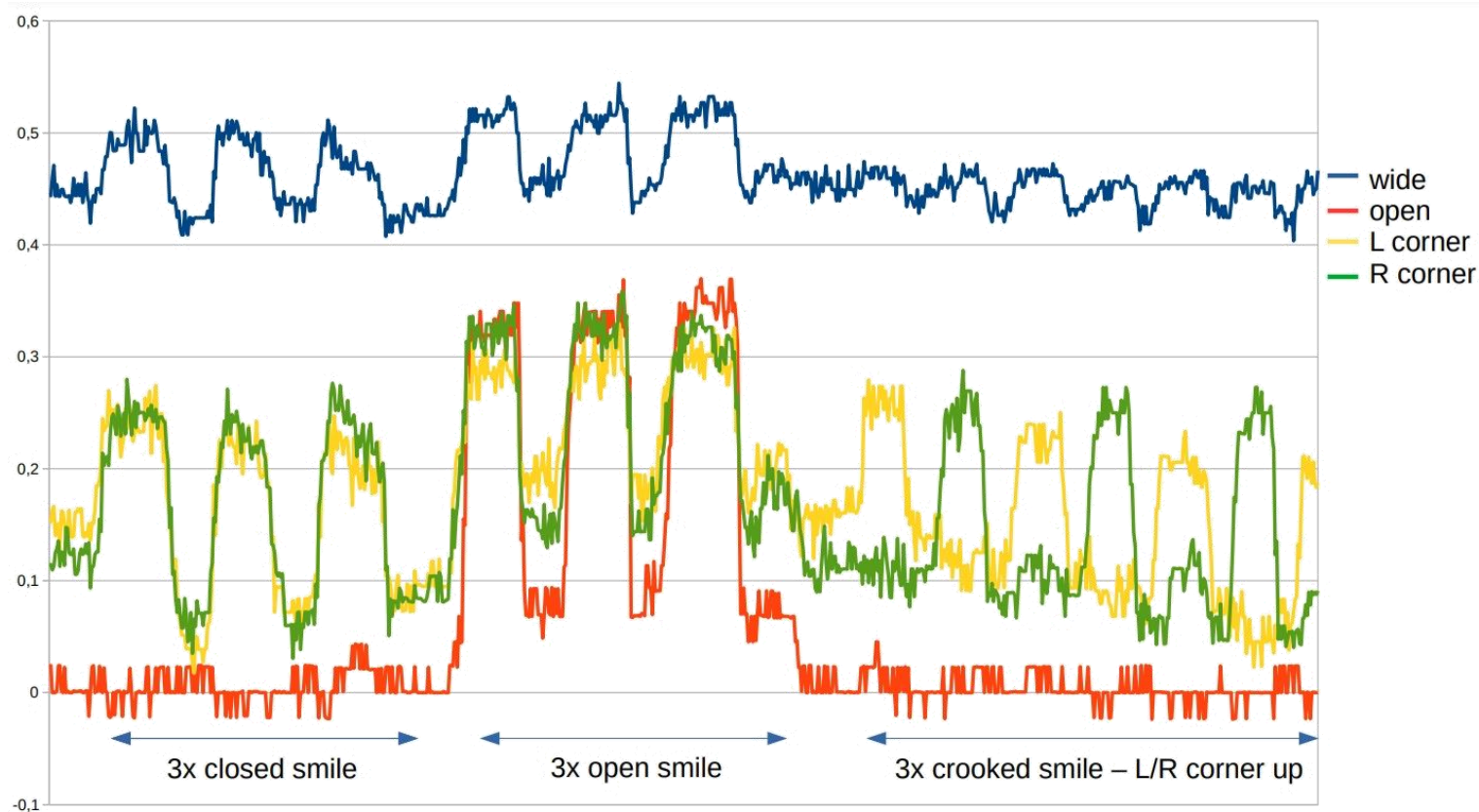
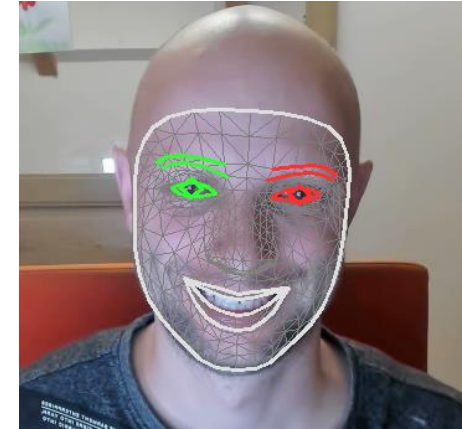
Automatic evaluation of speech therapy exercises



Augmented reality module leading the exercise moves

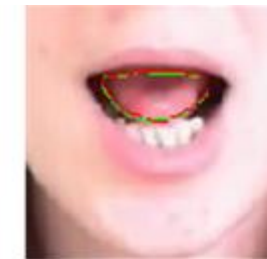
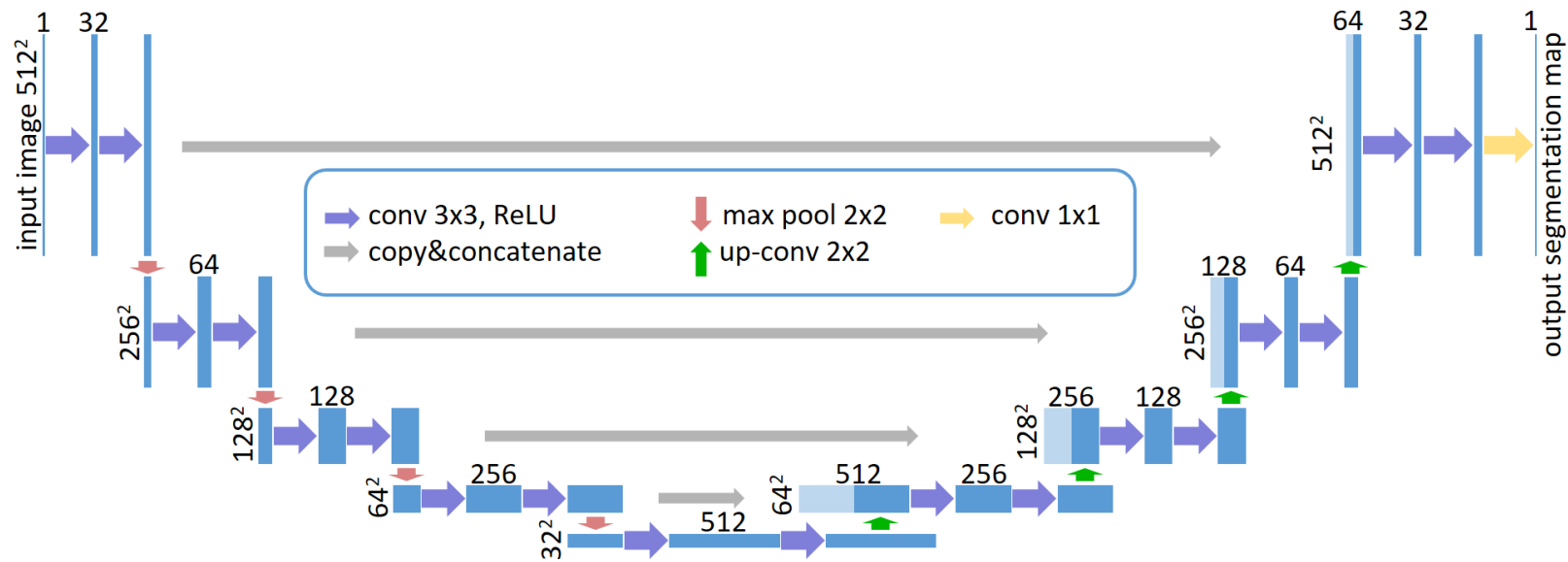
Lips Detection

- Facial keypoints acquired from MediaPipe library
- Specific combination of the features for each exercise



Detection of tongue and its tip

- Based on the convolutional neural network U-net
- Output two results - mask for tongue & mask for its tip



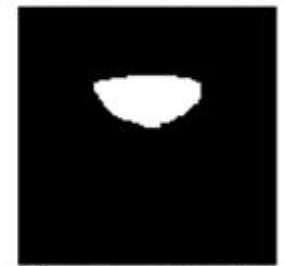
Prediction



Prediction of tip



Prediction thresholded

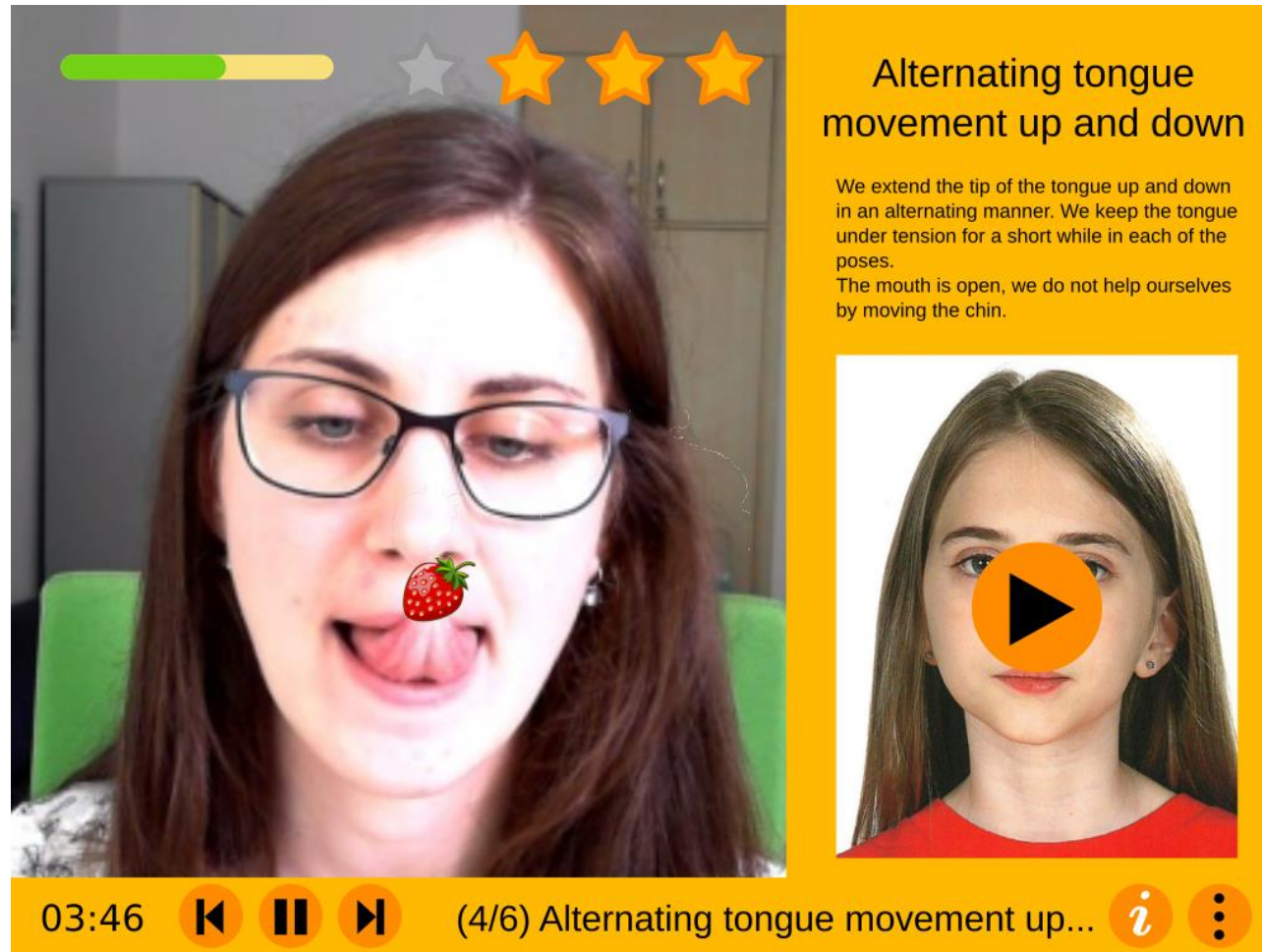


G=GT, R=Prediction



ASSISLT

Automated Software System for Speech Therapy



03:46 ⏮ ⏪ ⏩ ⏭ (4/6) Alternating tongue movement up... ⓘ ⋮

Alternating tongue movement up and down

We extend the tip of the tongue up and down in an alternating manner. We keep the tongue under tension for a short while in each of the poses.
The mouth is open, we do not help ourselves by moving the chin.

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Automatic annotation tool for image-based collections



- Vienna City Library
 - Over 350.000 posters
- Poof-of-Concept for automatic annotation tool
 - 5000 posters

OCR in the Wild



Input



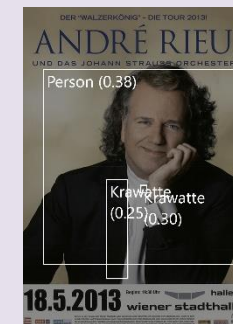
Face detection & recognition



Image Retrieval



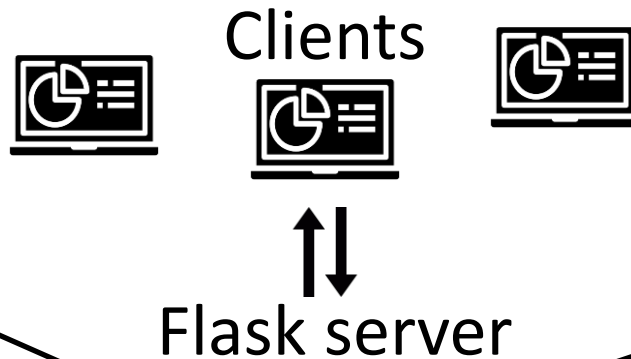
Object detection



Tesseract / EasyOCR / ...



Final System



MTCNN

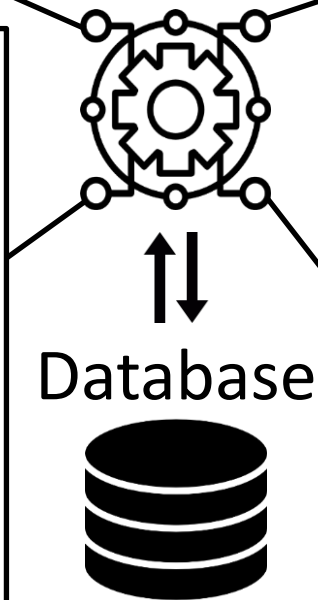
ARCFACE

Transfer Learning

query

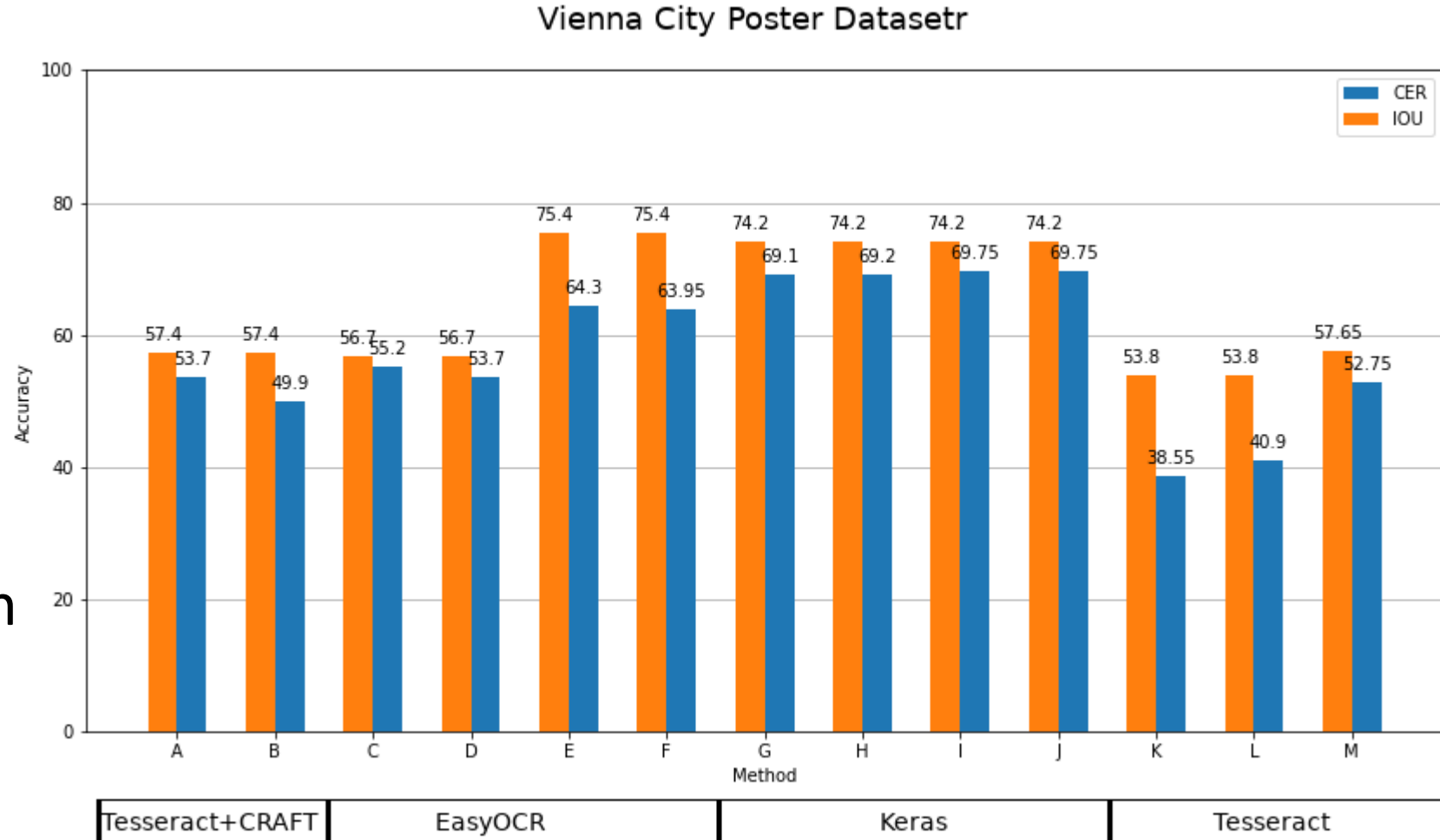
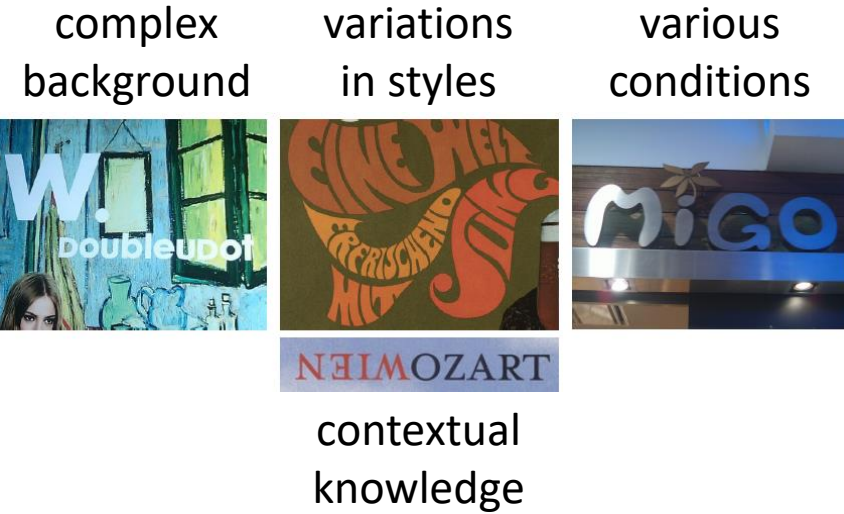


ResNet152/EfficientNet-b3/...



YOLOv5

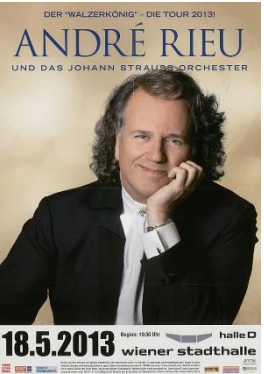
OCR



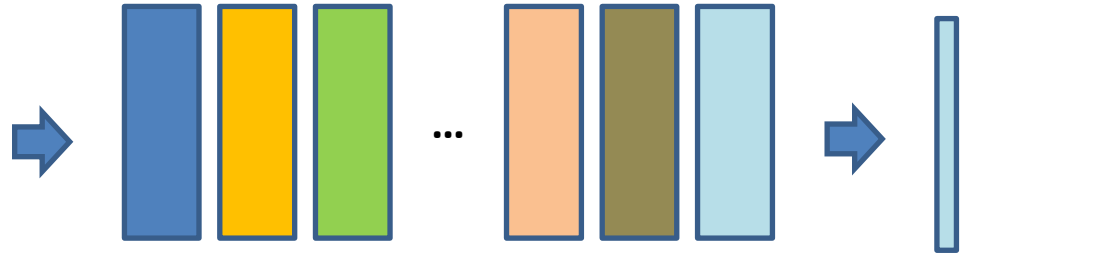
IoU : Intersection over Union
CER : Character Error Rate

Validated on 257 posters

Image Retrieval

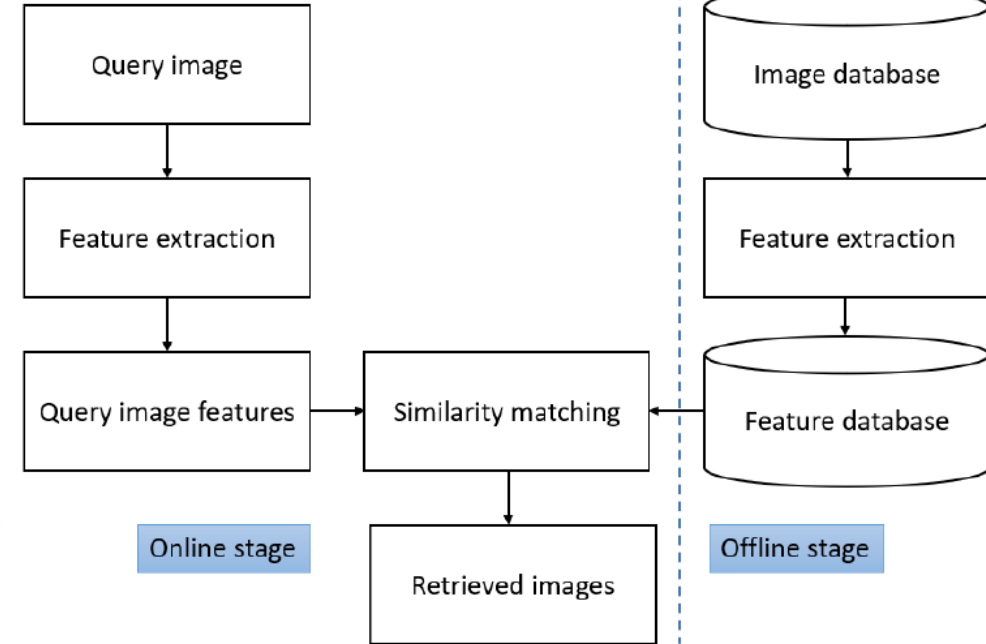


Input Image



Convolutional layers
Pooling
Normalization

Descriptor $1 \times n$



t-SNE visualization (EfficientNet)



Image Retrieval

Query images

2

3

4

5

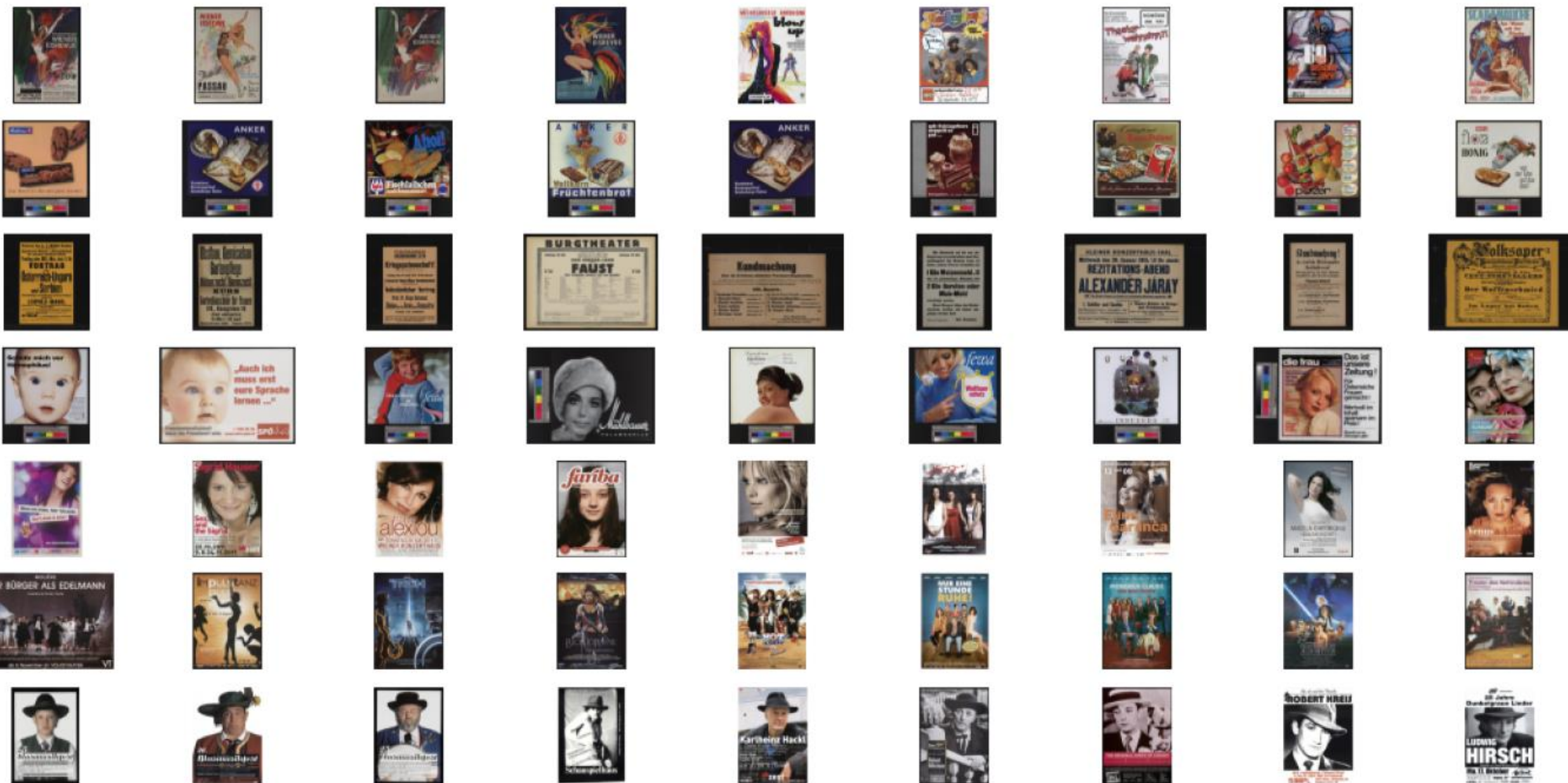
6

7

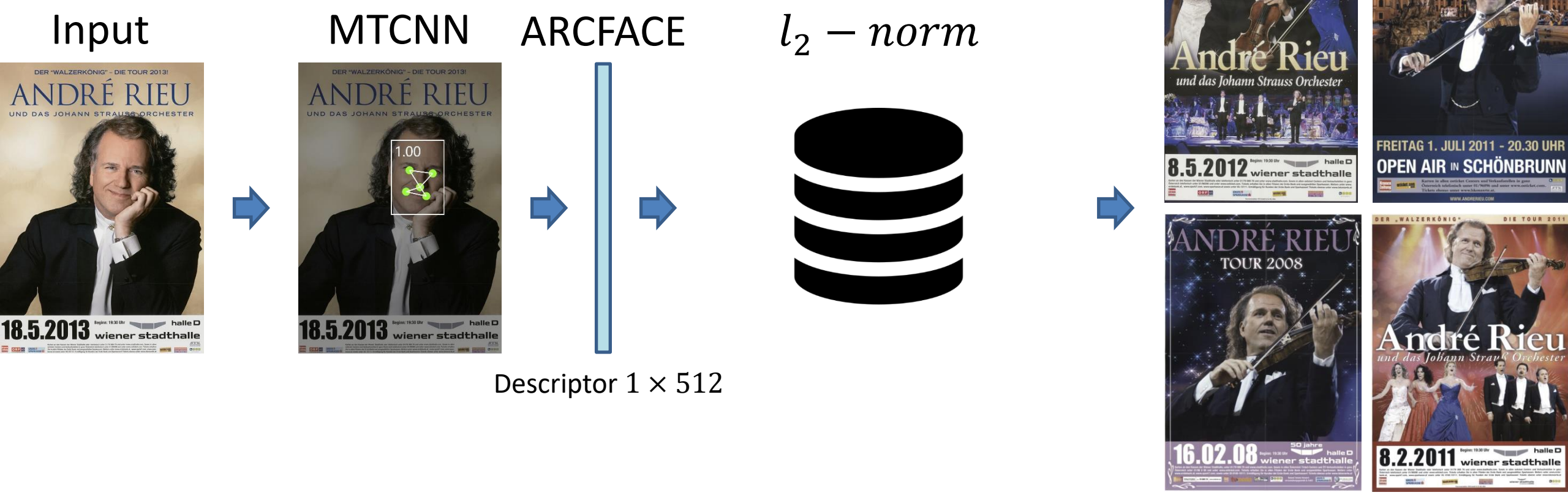
8

9

10



Face Detection & Recognition



Final System - Web application

Standardsuche Suche nach Gesichtern

Suche in Titel, Angaben zum Inhalt, Personen, Organisationen, Verantwortlich, Themen, Verlage, Datierung, Signatur, ID-Nr, OCR Text

4994 results found in 125ms Relevanz (absteigend) ⌵

Filter

Farbe

Sprachen
Sprachen auswählen ▾

Verlage
Verlage auswählen ▾

Verlagsorte
Orte auswählen ▾

Themen
Themen auswählen ▾

Formate
Formate auswählen ▾

Personen
Personen auswählen ▾

Organisationen
Organisationen auswählen ▾

Datierung (Jahr)

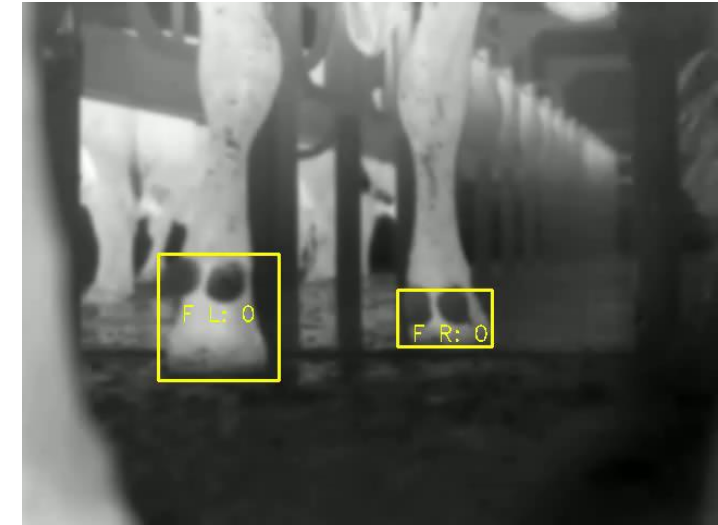
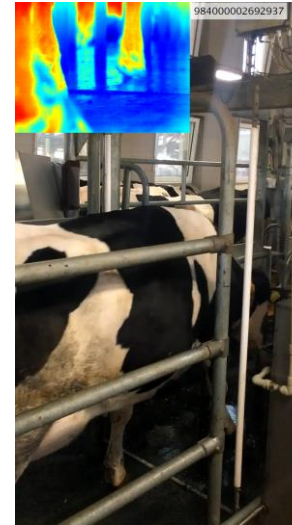
1870 2020

 Immer Oberwasser mit Cole of California Allein Lizenz: Charnaux 1960 2 Bogen: 170x122 cm	 World Mental Health Day 2010 1 Plakat: farb.: 42 x 29,5 cm	 Julius Deutschbauer & Ruth Glowacki ... Meine Schwester - ein zum Gedankenstrich... 2013 1 Plakat: farb.: 85 x 60 cm	 Strawanzer ... Ein Film von Peter Patzak 1984 1 Plakat (2 Teile): farb.: 118 x 84 cm	 Zum ersten Mal in Europa: Royal Thai Ballet ... Konzerthaus ... 22. September 1982 1982 1 Plakat: farb.: 84 x 59 cm
 Alles frisch auf den Tisch Elin Union Kühlschränke 1963 1 Bogen: 34 x 37 cm	 Plakazin.at ... Ruskaja ... Eutopia 2008 1 Plakat: farb.: 85 x 60 cm	 Forum Praterstern lädt ein ... Es spricht: Finanzminister Dr. Herbert Salcher ... 17. November... 1983 1 Plakat (2 Teile): farb.: 118 x 84 cm	 Ignis Kühlschränke 1960 2 Bogen: 169x119 cm	 Wien ist Istanbul. Wien ist Chicago. Wien ist Palermo. Wien ist Wien ... Eine Iomographische... 2005 1 Plakat: farb.: 85 x 60 cm
 Holland im Schauspielhaus ... Zwei Stimmen ... Pier Paolo Pasolini, Cor Herkströter ... 7. ... 2001 1 Plakat: farb.: 85 x 60 cm	 Klaus Staeck Plakate aus den Beständen des Museums 6. August - 29. September 1987... 1987 1 Bogen: 84x57,5 cm	 Schauspielhaus ... Medea Wiederaufnahme! Ab 9. April 2002 2002 1 Plakat: farb.: 85 x 60 cm	 Budapest ... Spiegel unserer Geschichte ... Ausstellung in der Wiener Planungswerkstatt ... 4... 2004 1 Plakat: farb.: 85 x 60 cm	 Hoover Keymatic 1963 2 Bogen: 167 x 119 cm

Other Selected Projects

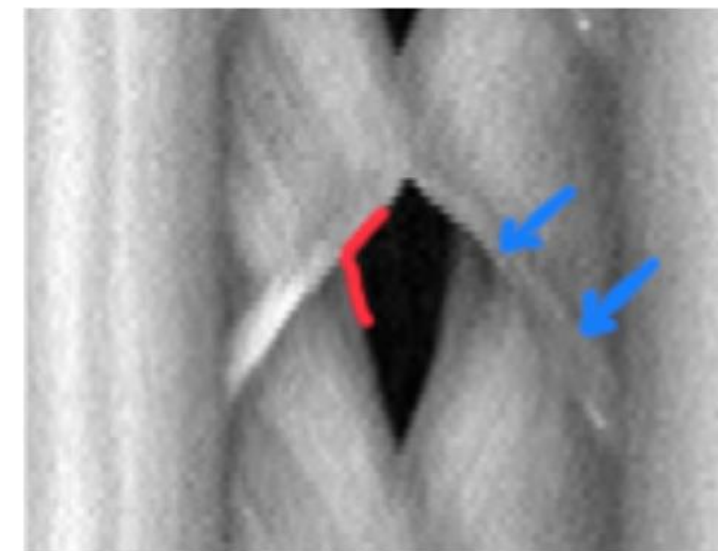
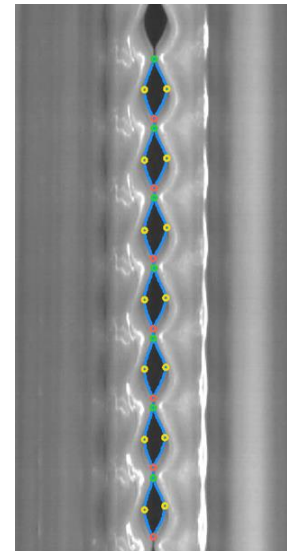
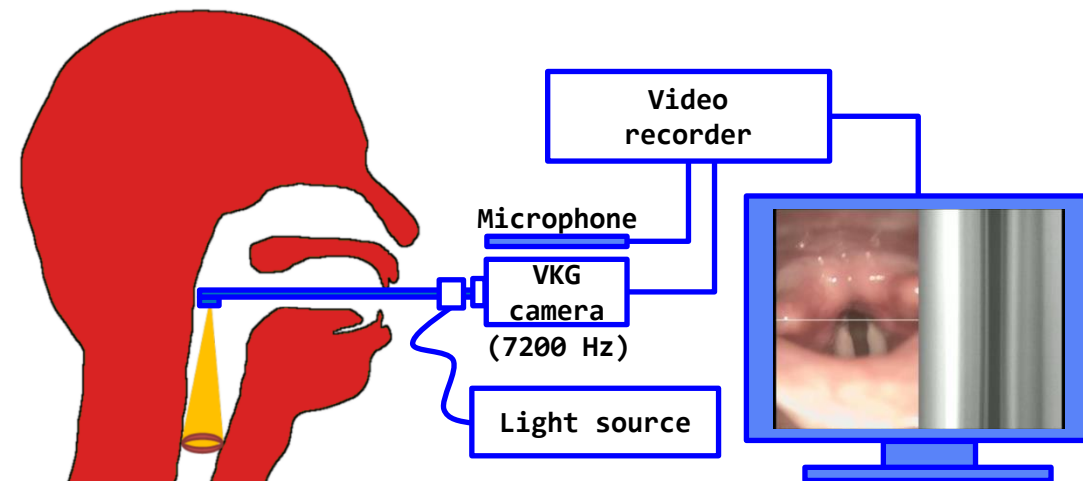
Agriculture

Estimation of Temperature Index
Based On The Cows Legs



Medicine

Detection of the glottis



Thank you for your attention!

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