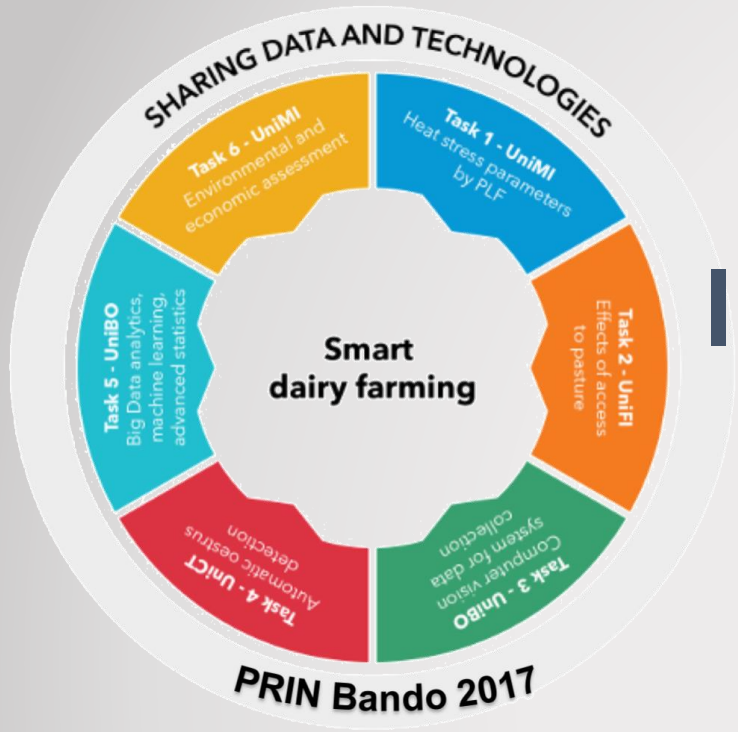


CowBhave
CowData

Innovation for Smart Dairy Farming

PRIN2017: Application of computer vision systems for herd management

Stefano Benni, Marco Bovo, Daniele Torreggiani, Alberto Barbaresi, Enrica Santolini, Miki Agrusti, Mattia Ceccarelli, Patrizia Tassinari

Department of Agricultural and Food Sciences – Alma Mater Studiorum Università di Bologna

Special Session of the 6th International Conference on Safety, Health and Welfare in Agriculture and Agro-food Systems "Ragusa SHWA 2021"

Innovative computer vision system
Objectives and expected results

OBJECTIVES

Development of a computer vision system for:

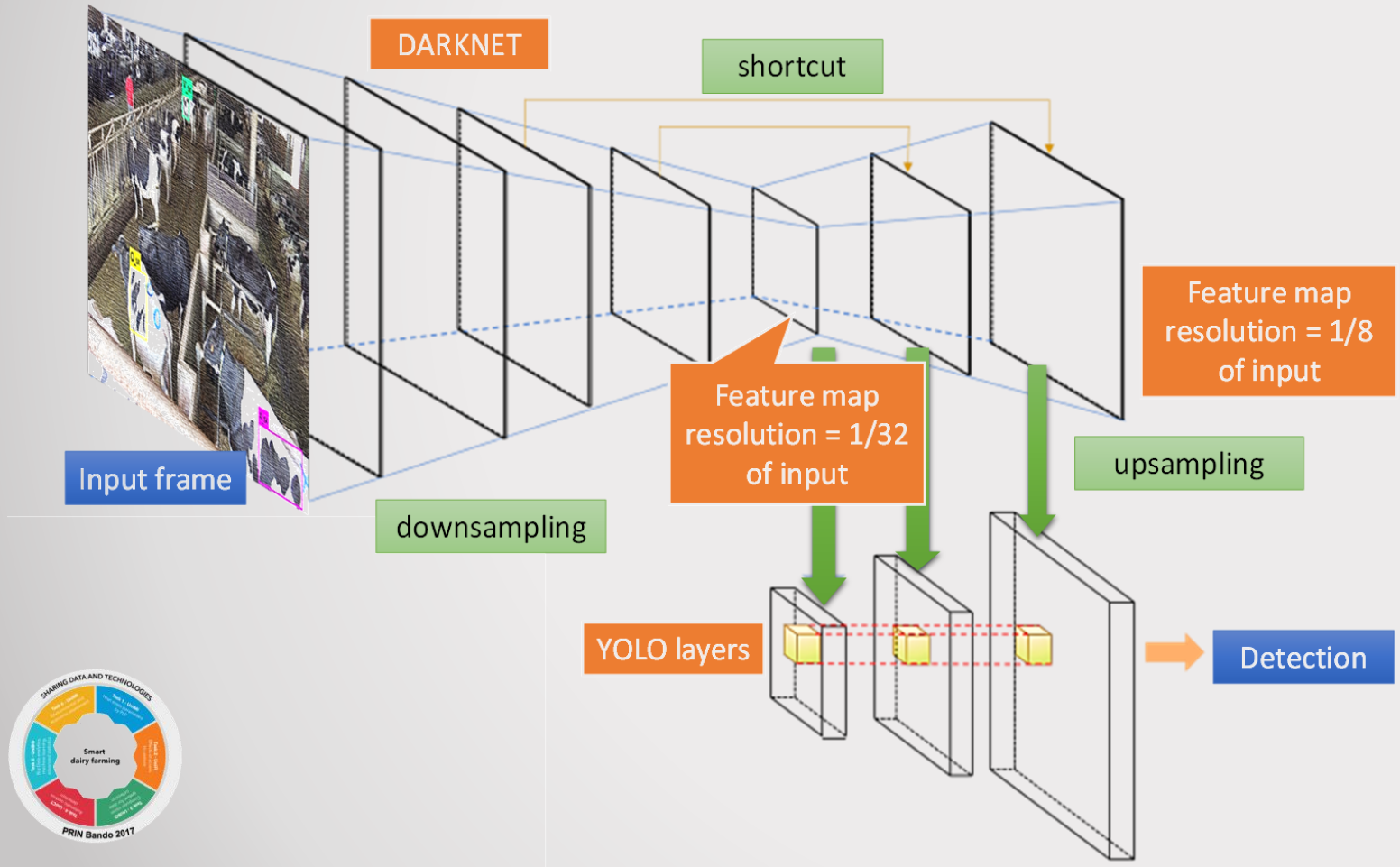
- automatic detection and real-time monitoring of each cow
- monitoring and recording drinking behaviour data of each cow

EXPECTED RESULTS

- Definition of a new computer vision system based on deep-learning technique and evaluation of its performances

Materials and methods: neural network

- Darknet (Redmon, 2013), open source framework for neural network development including YOLO v3.
- Advantage to look at the whole image at test time: predictions informed by the global context
- YOLOv3 predicts an objectness score for each bounding box using logistic regression



Study case selection, set up and video recording

Tagging video frames

Training of the network

Validation and test of the network

Tracking by detection

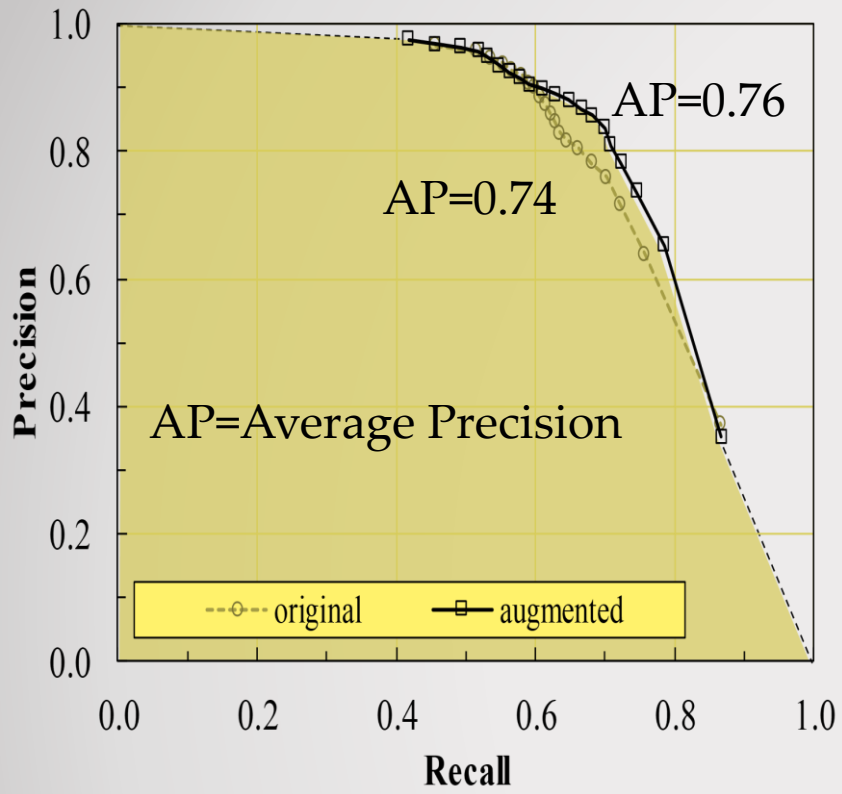
Computer vision system for automatic detection and real-time monitoring of each cow

...

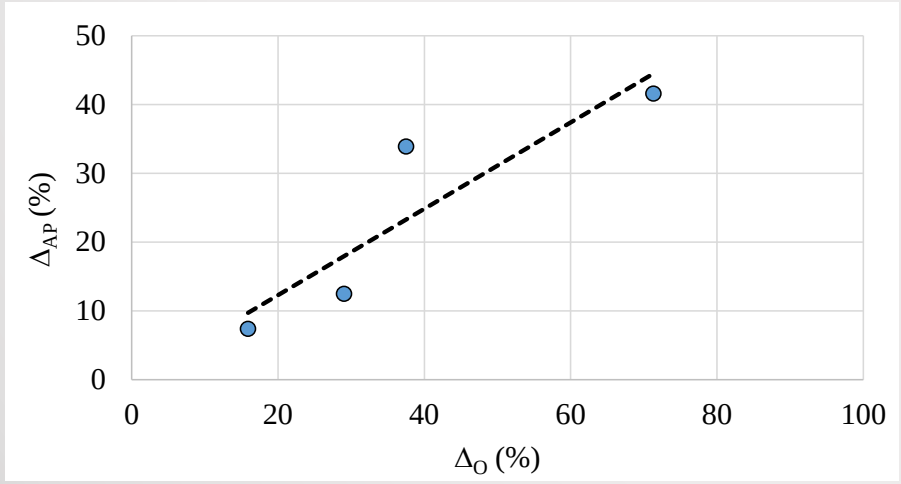
Materials and methods: study case

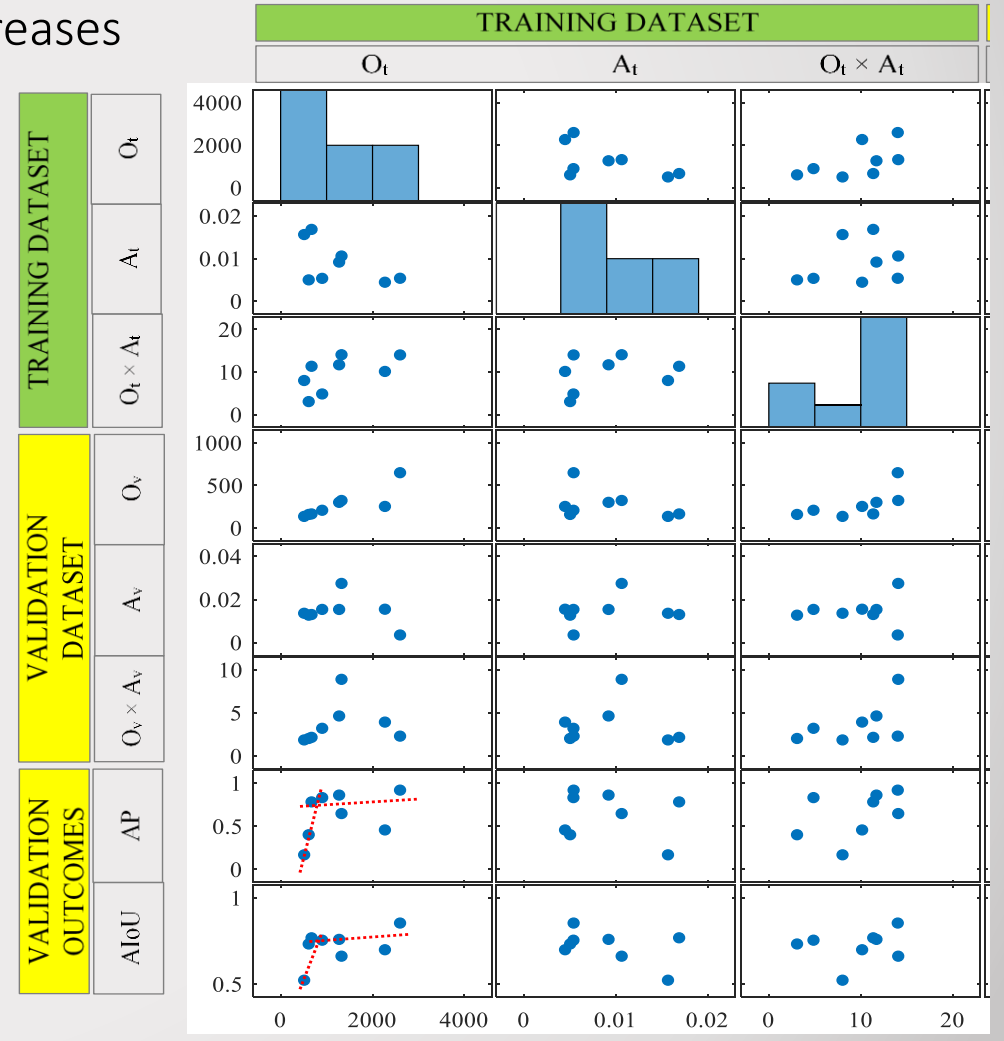
- Freestall barn with 72 milking and 8 dry cows, and 70 among calves and heifers.
- Cublicles with straw litter for lactating cows; straw bedding for dry and young animals.
- Videos recorded by HDR-CX115E (Sony) in a high quality standard (4k resolution, 25 fps)
- Fixed camera height 3.50 m; scene included 29 lactating cows.
- 210 min recorded; 25200 frames
- identify individual cows based on the piebald spotting pattern

Results



- By increasing the number of occurrences O_t until a certain "threshold", AP increases, then low slope
- good quadratic regression curve of the relationship between AP and $O_t x A_t$: classes having $O_t x A_t > 8$, AP rapidly increases up to $O_t x A_t$ 12, then it becomes almost constant



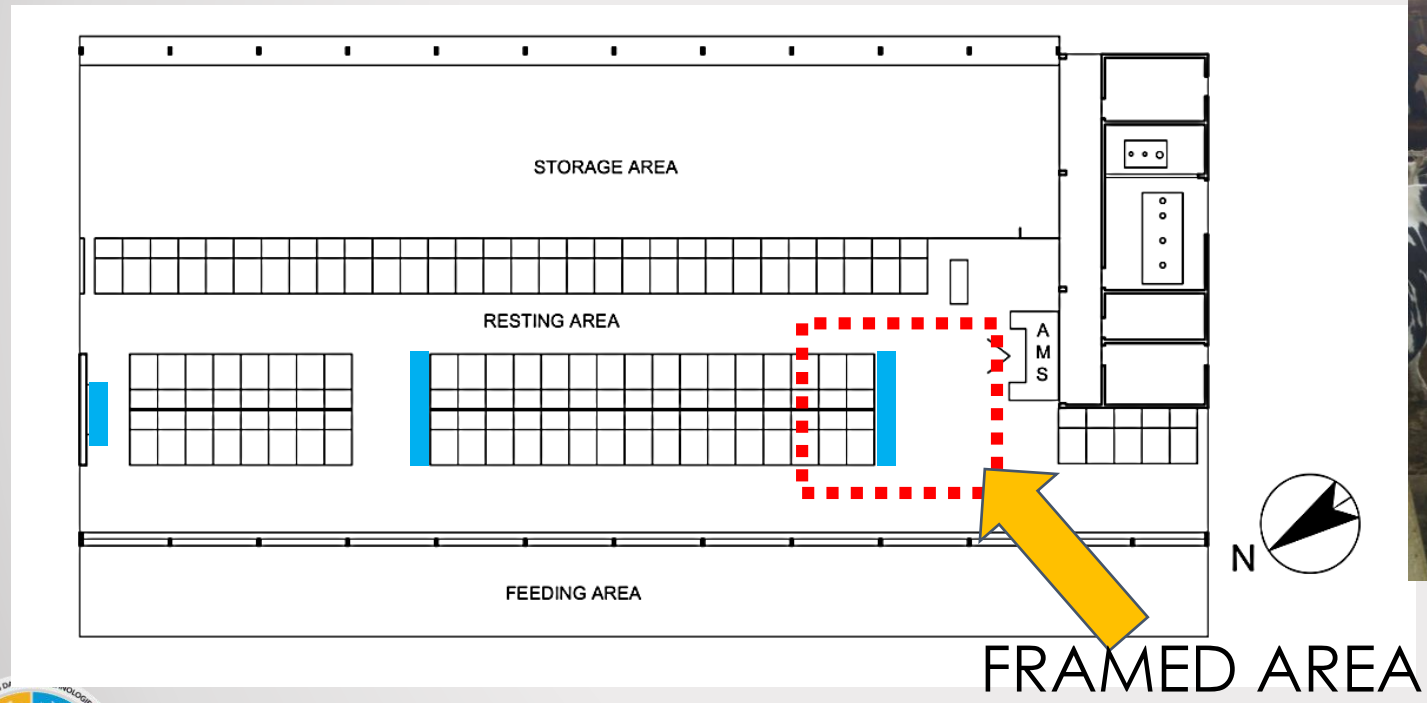


Monitoring and recording drinking behaviour data of each cow

...

Materials and methods: study case

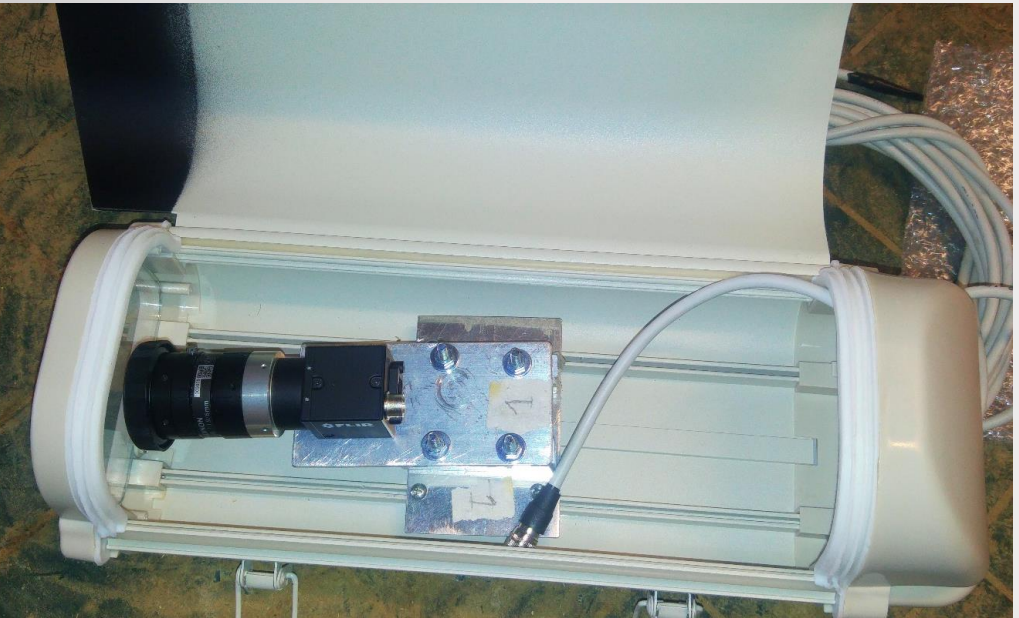
- Regular rectangular barn (51x23 m);
- 78 beddings filled with sawdust and realized over three lanes
- Robot Lely Astronaut A3 Next
- Mechanic ventilation system + water soaker line activated on the basis of indoor THI
- The farm hosts 60-70 milking cows



The position of the camera was properly selected in order to guarantee the framing of a large area surrounding one of the drinking trough

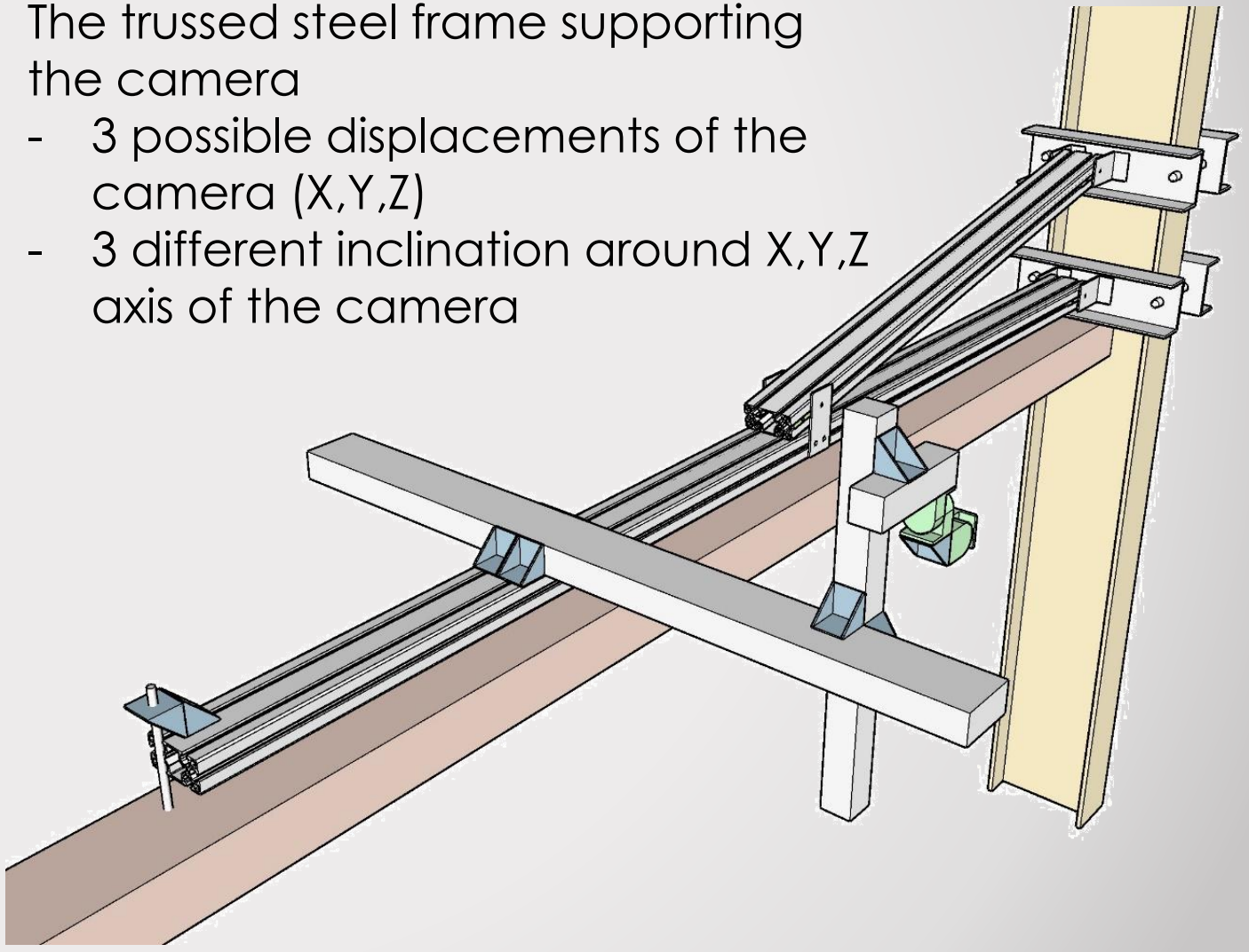
Materials and methods: hardware equipment

- Camera Flir BFLY-PGE-31S4C-C with a 6mm lens
- Camera resolution: 3.2 megapixel
- Use of a protection case



The trussed steel frame supporting the camera

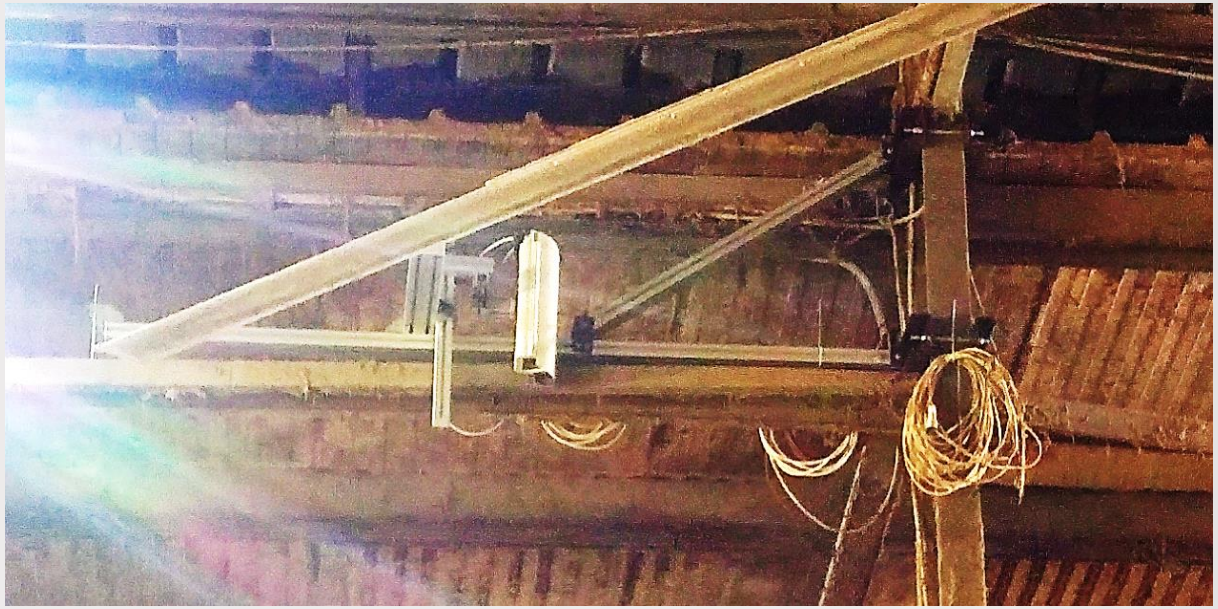
- 3 possible displacements of the camera (X,Y,Z)
- 3 different inclination around X,Y,Z axis of the camera

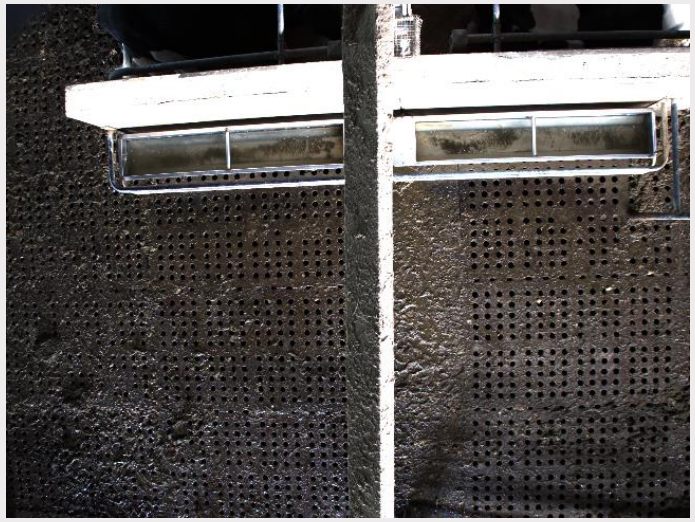


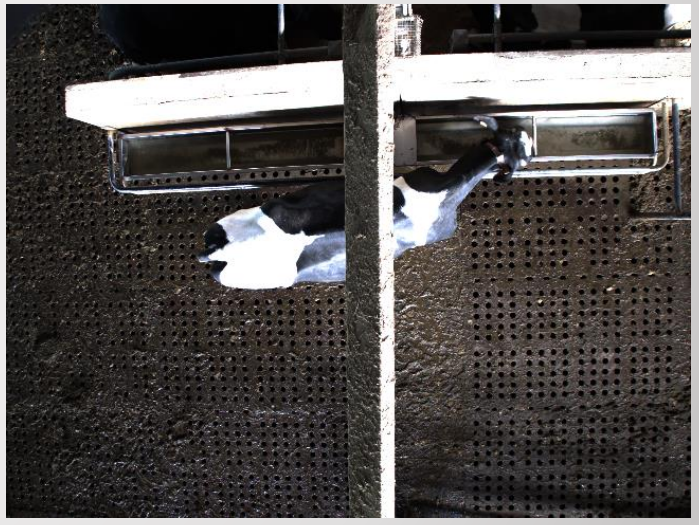
Hardware installation

BEFORE

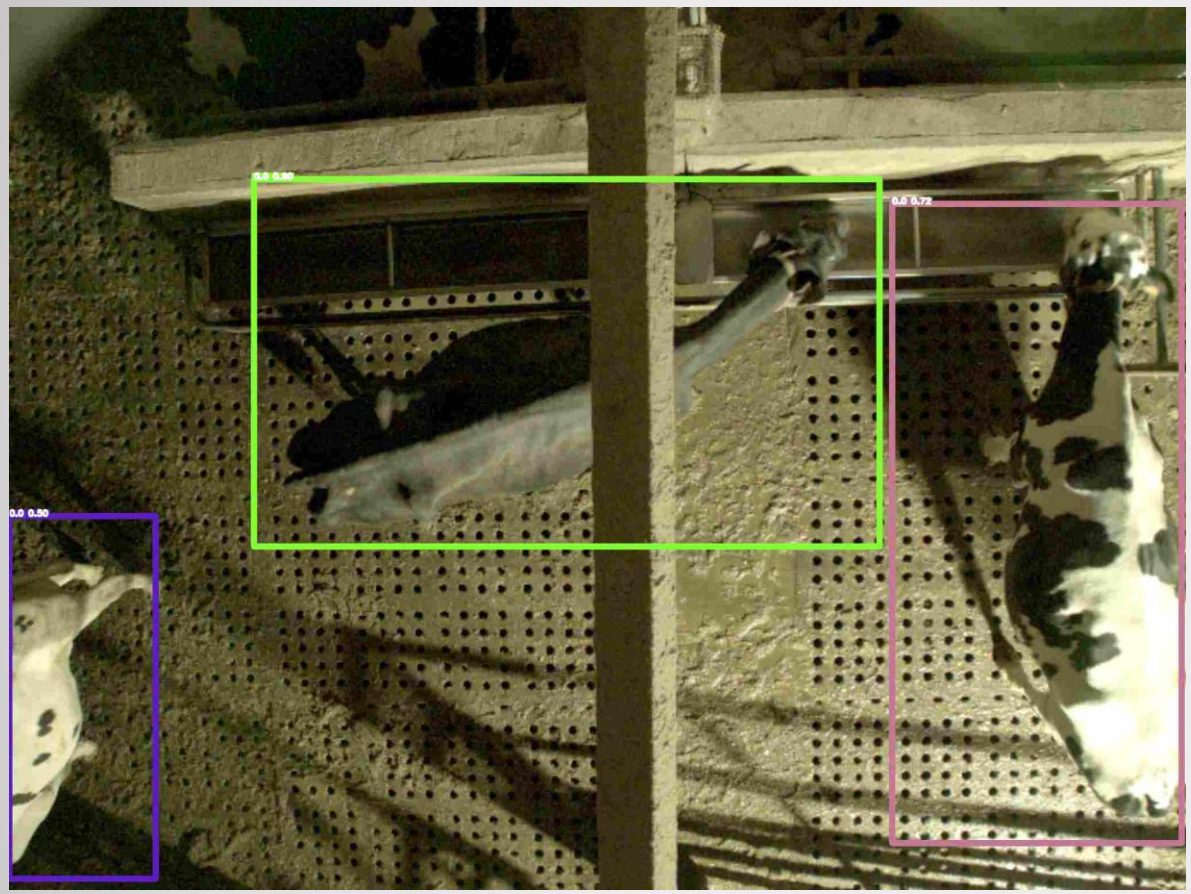
NOW



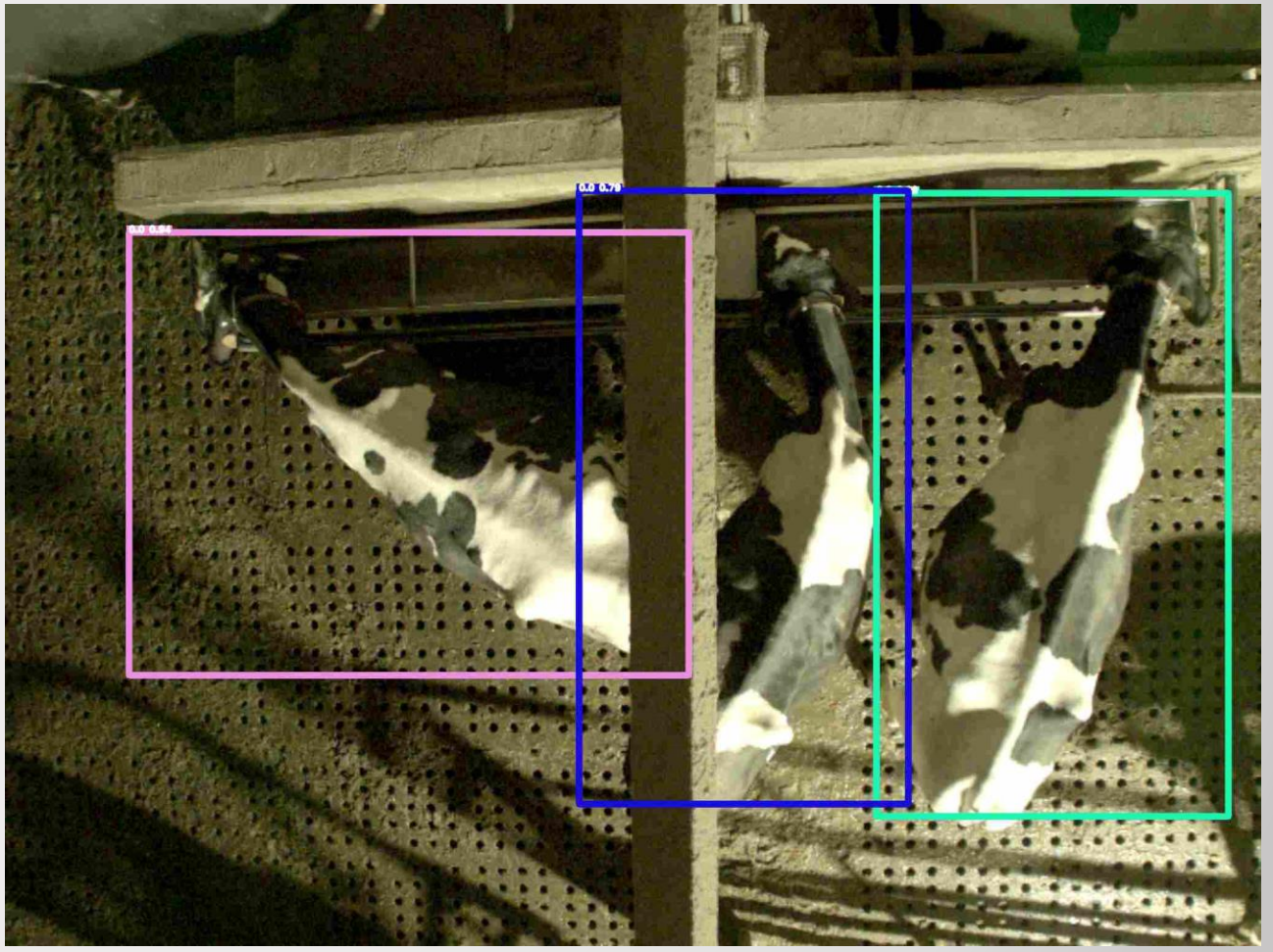




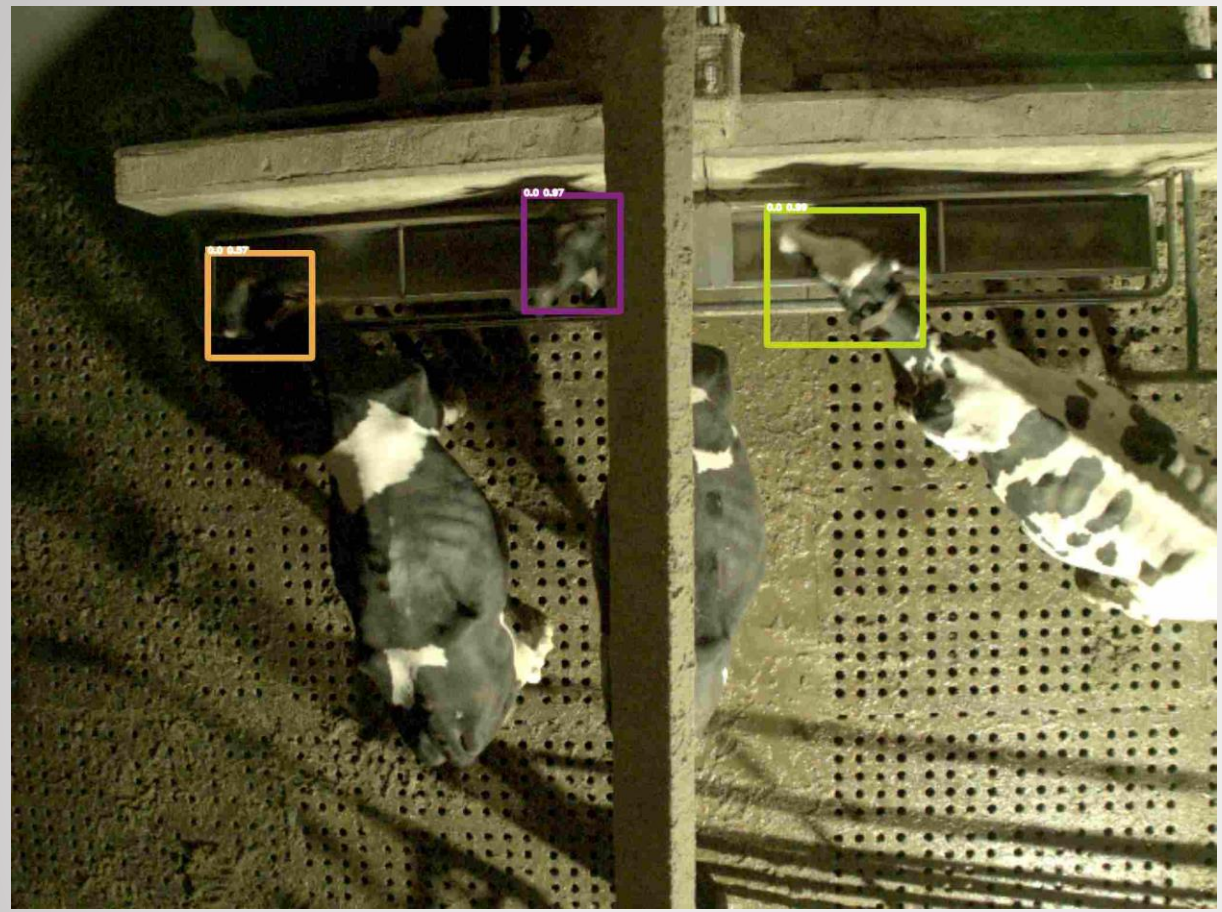
First results



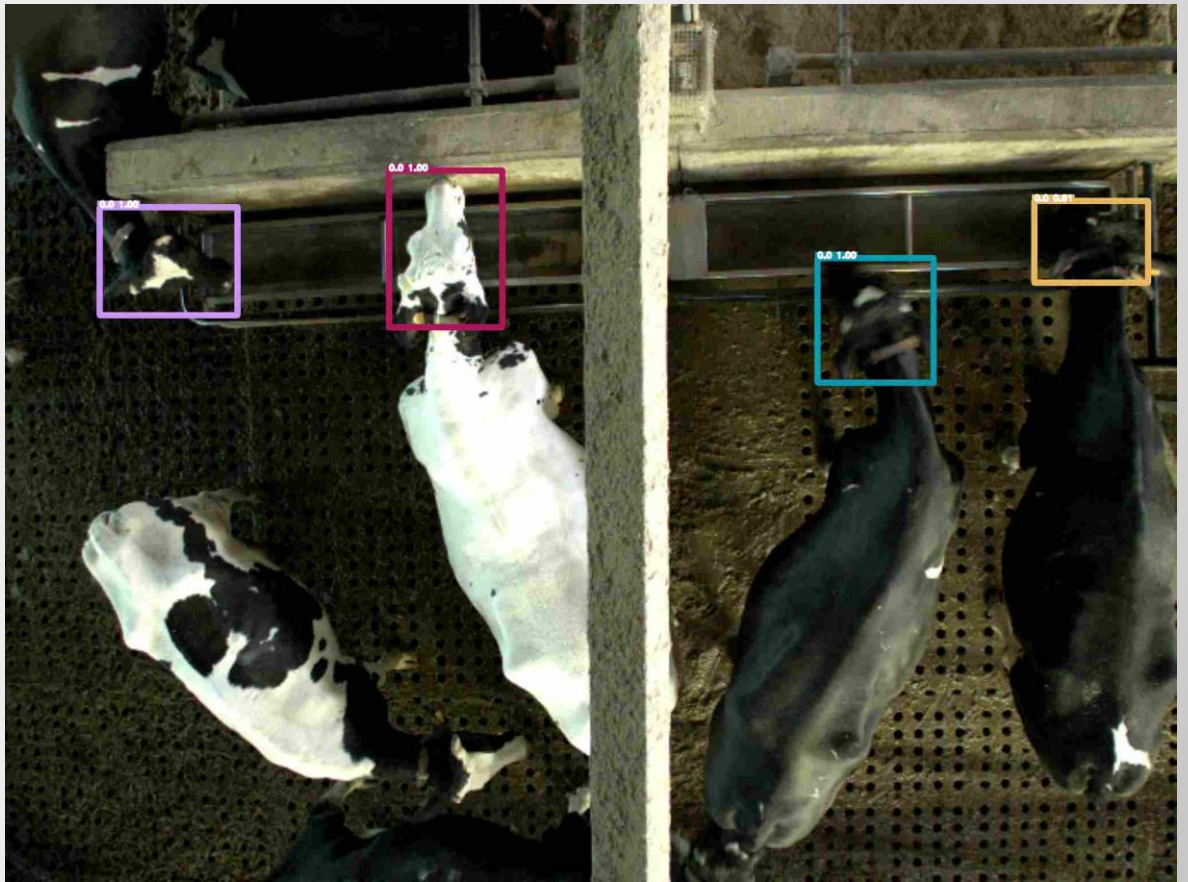
Detection of individual cows in the monitored area



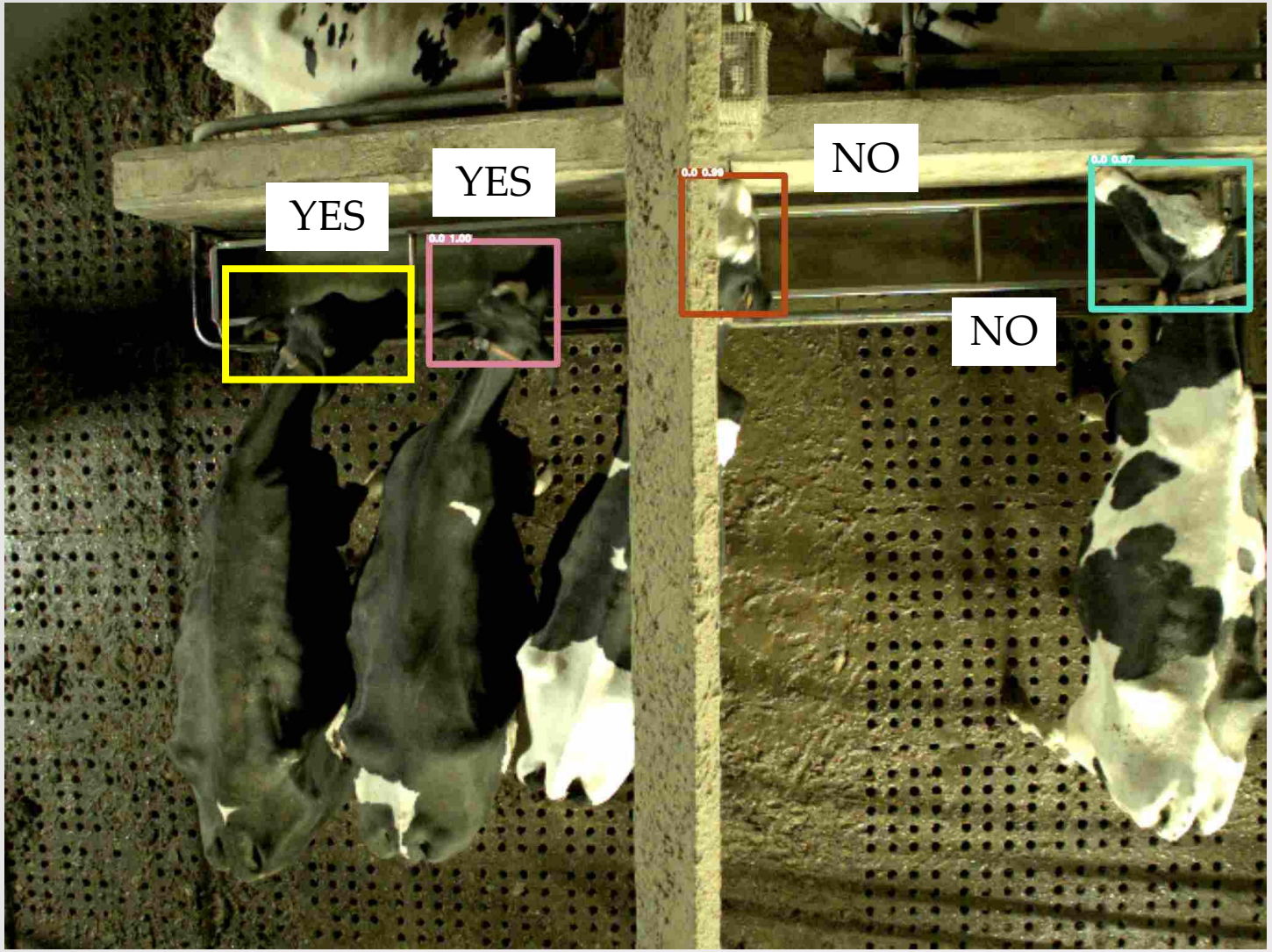
First results



Pose classification: identification of the drinking behaviour

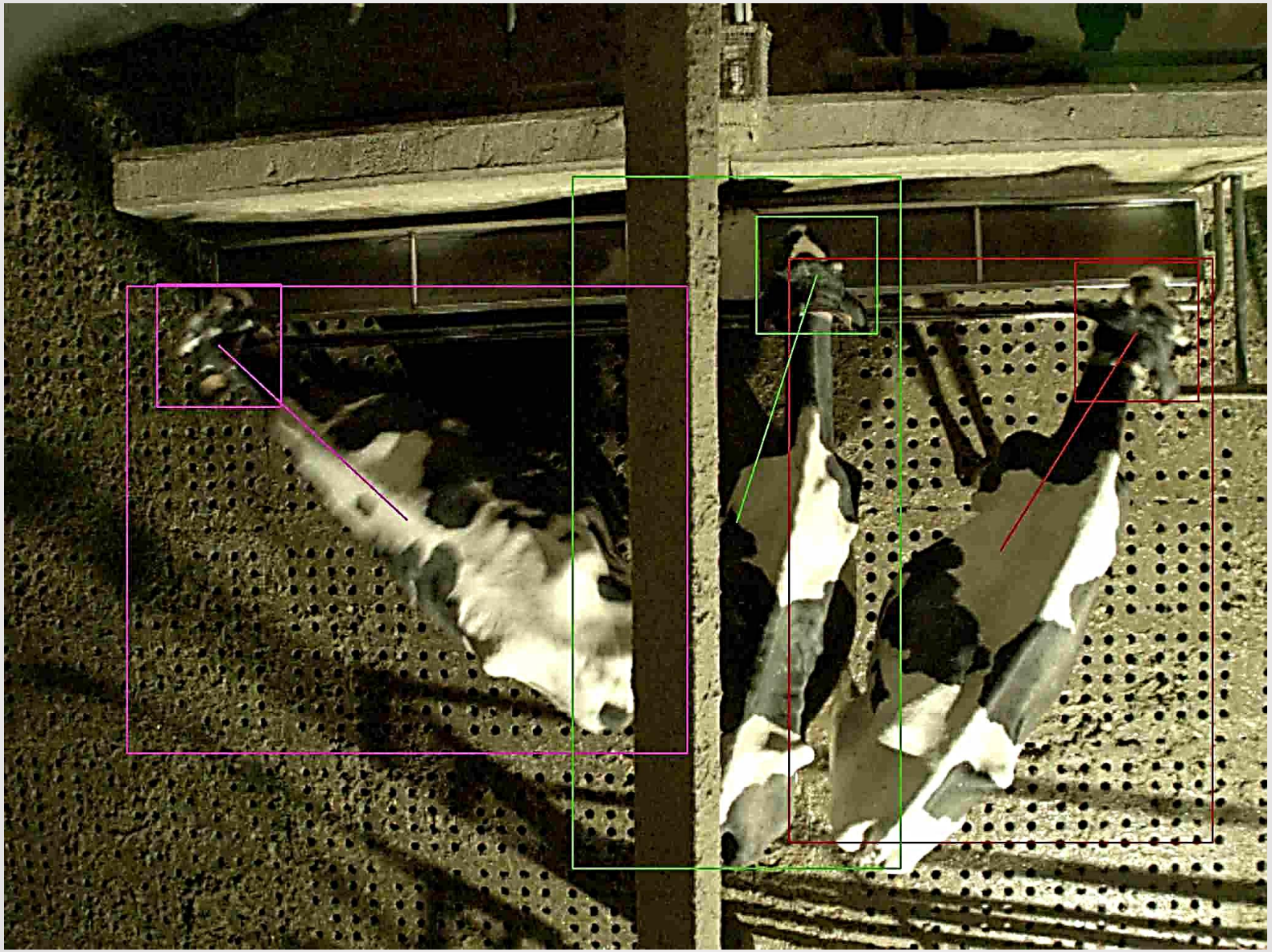


PHASE 1: detection of the heads



PHASE 2: classification of heads drinking/not drinking

PHASE 3: association head-body of drinking cows



Intermediate remarks (2° year of project)

- Computer vision is suitable to identify individual Frisian cows in a dairy barn based on their morphological appearance
- One camera can monitor a significant part of the barn and provide information for manifold animals
- A relation was found between detection precision and number of occurrences x frame area: useful to efficiently plan the imege acquisition to train the
- Data augmentation confirmed to be effective to improve performances of the network
- Computer vision can be applied to detect cows drinking
- The identification of cows at the water trough and the detection of their heads is feasible with a computer vision approach

ACKNOWLEDGMENT

The authors wish to thank the Azienda Agricola Piazzi, located in Budrio (Bologna), Italy, for the availability and the collaboration during the survey and the research activities.

FUNDING

The activity presented in the paper is part of the research project PRIN 2017 "Smart dairy farming: innovative solutions to improve herd productivity" funded by the Italian Ministry of Education, University and Research [20178AN8NC].

CowBhave
CowData

Thanks for your attention

E-mail of the components of the RU#4:
stefano.benni@unibo.it
marco.bovo@unibo.it
daniele.torreggiani@unibo.it
alberto.barbaresi@unibo.it
enrica.santolini@unibo.it
miki.agrusti@unibo.it
mattia.ceccarelli5@unibo.it
patrizia.tassinari@unibo.it

PRIN2017: Smart Dairy Farming – innovative solutions for herd management

Visit the website of the project: www.dairysmart.unimi.it