Viral Final Meeting
University of Banja Luka
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AimHigh Project

HPC and AI/ML for Computer Vision in Smart Poultry Farms

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The Problem + questions

- How do we address the **growing demand for food** and animal protein?
- How do we **scale and optimize animal farming process** to answer the needs of the global meat market?
- Can we use AI advancement to contribute in **optimization** of poultry farming?

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Main focus

- Project was focused on poultry farms and the following challenges:
  - **Disease** outbreaks among chickens;
  - **Dead chickens** that need to be removed;
  - All the basic life needs: feed, water, lighting, air;
  - **Sanitation** and **cleaning**;
- All of that while ensuring animal well-being and to make the life for farmers easier.

Project goals

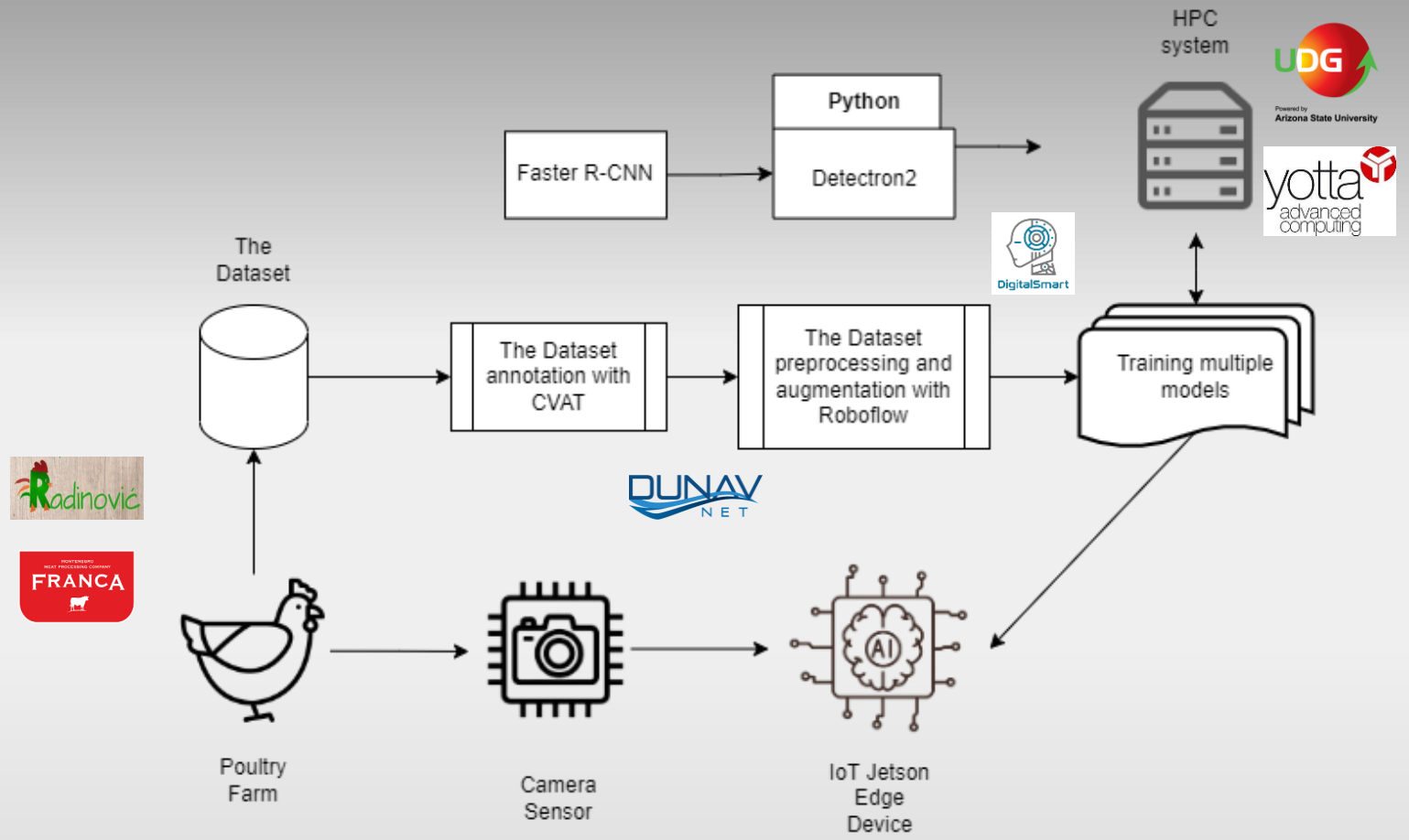
- Create advanced poultry farm camera **sensors** based on deep learning and IoT edge devices.
- The use of HPC to support development of **new smart IoT sensors** for poultry farms, based on Edge AI/DL computer vision and faster process of development AI models.
- Enabling deployment on the edge devices equipped with camera sensors.

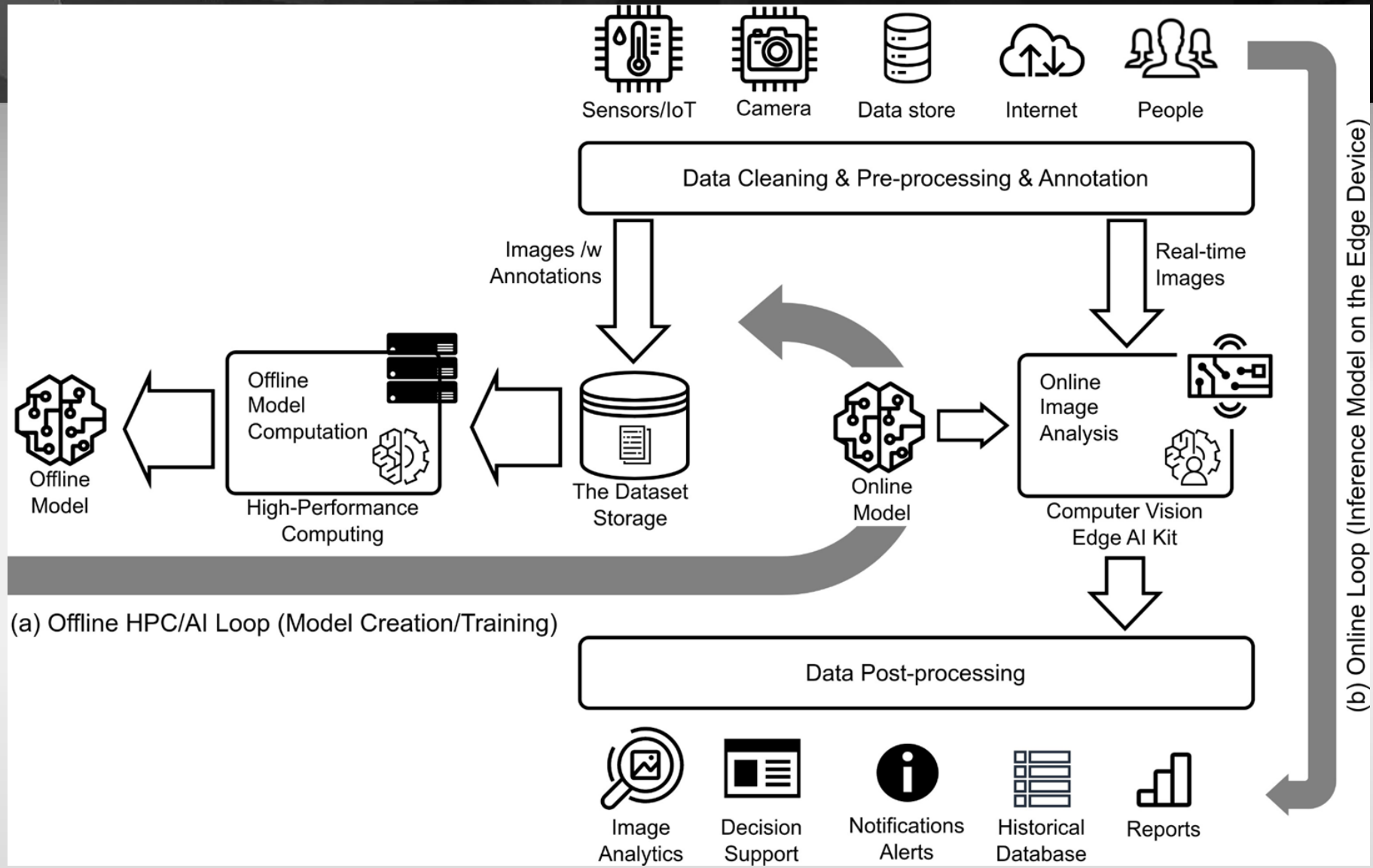
Project key tasks

- Object detection
  - Chicken/poultry counting
  - Detection of dead chickens
- Object segmentation
  - Estimation of the weight of the chicken
- AutoML
  - Hyperparameters optimization (HPO)

Implementation phases

Architecture



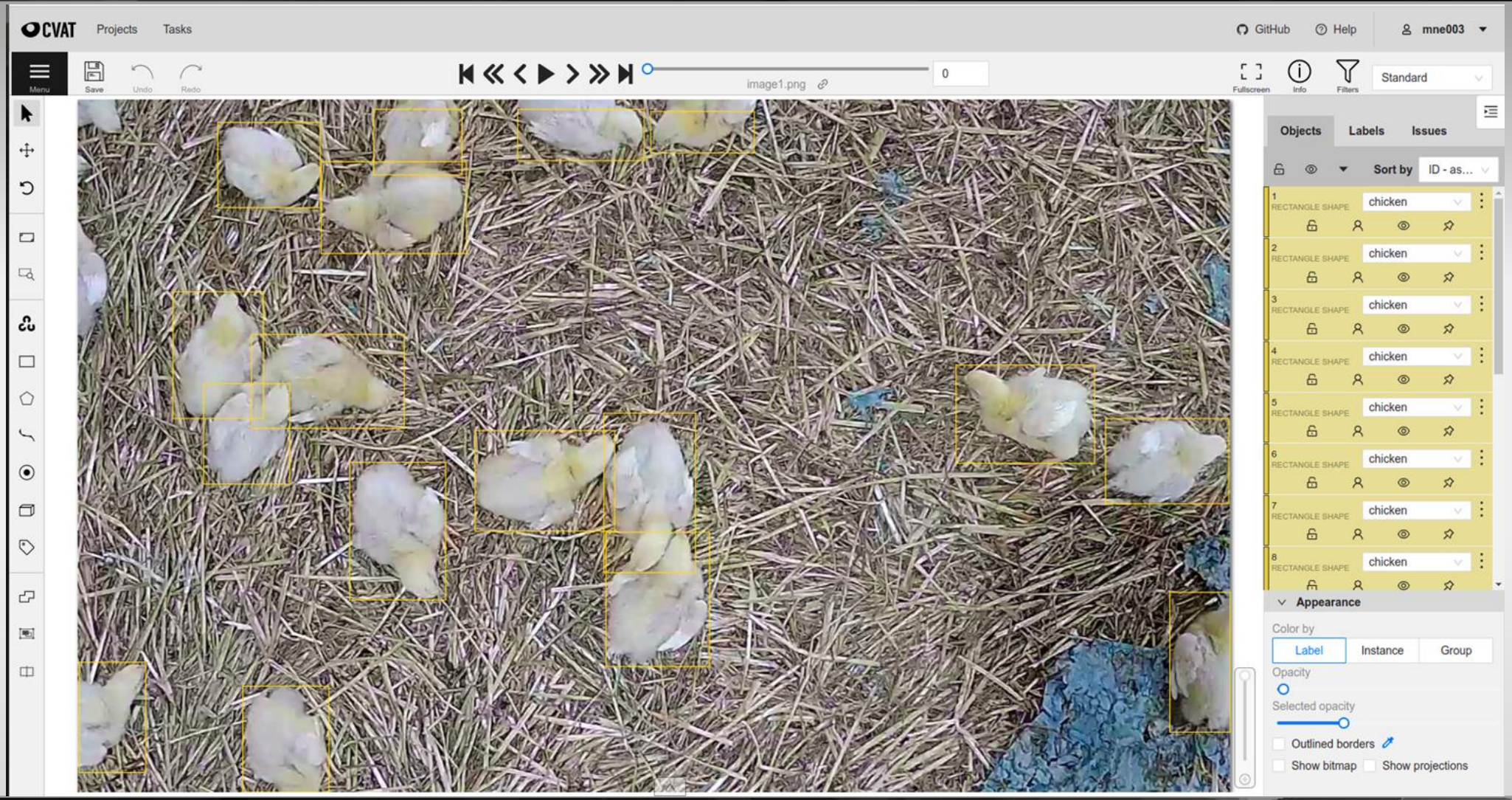


Cakic, S.; Popovic, T.; Krco, S.; Nedic, D.; Babic, D.; Jovovic, I. Developing Edge AI Computer Vision for Smart Poultry Farms Using Deep Learning and HPC. Sensors 2023, 23

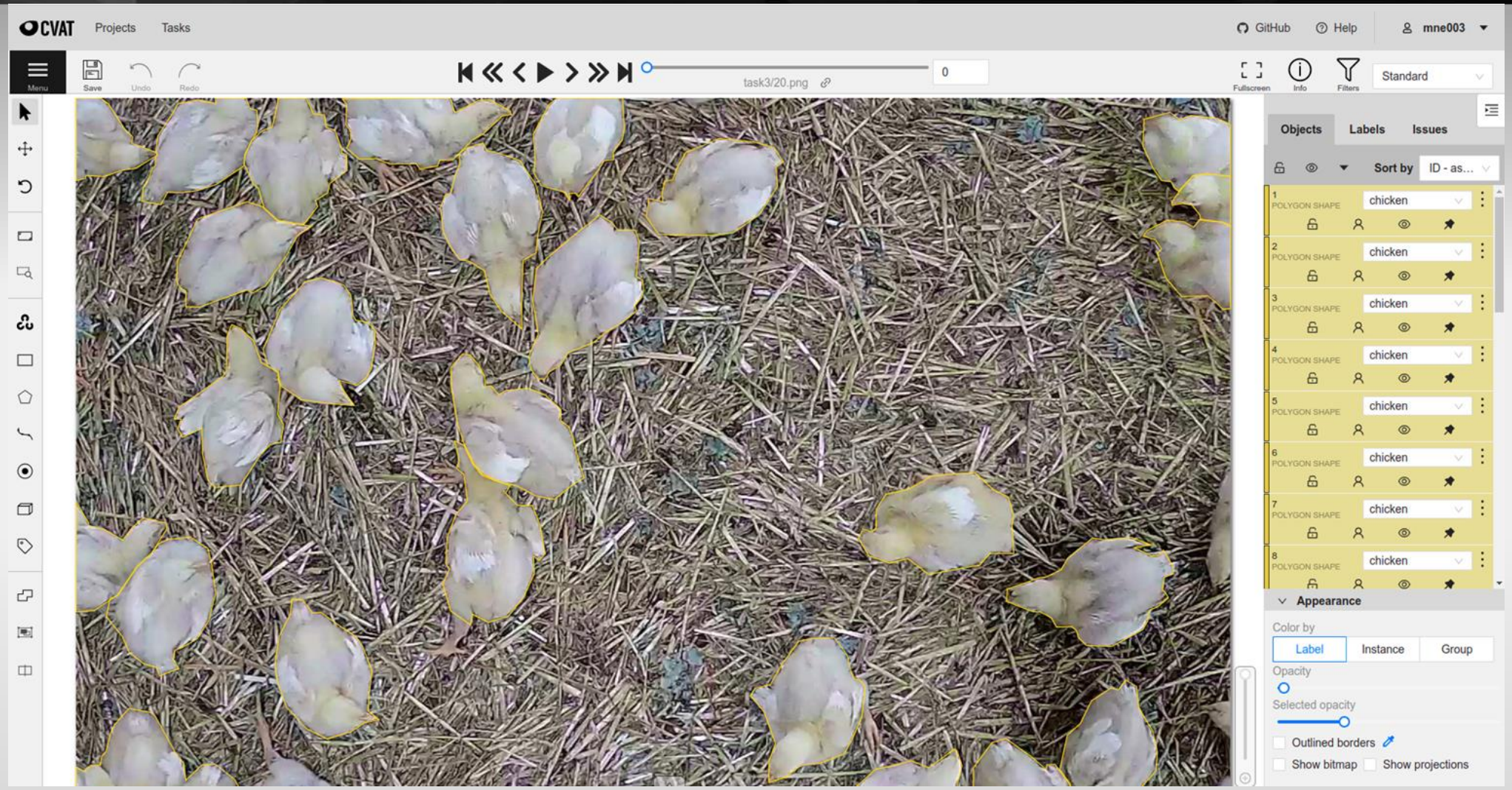
Data creation and preparation

- Dataset was extended from DunavNet dataset
- ~4000 annotated images for **object detection**
- ~1000 annotated images for **object segmentation**
- **Data augmentation**
  - **RoboFlow** for augmentation images for object detection
    (x3 expend for free on training dataset, ~9000 images after augmentation)
  - **Roboflow** has recently made it possible to augment object segmentation data
    (after augmentation ~2400)

Data labeling, object detection



Data labeling, object segmentation



Exploring different deep learning models

- Training on high-performance computing system
- More than three thousand experiments on one or multiple GPUs
- Fine tune hyperparameters (AutoML, HPO) and decrease training time.

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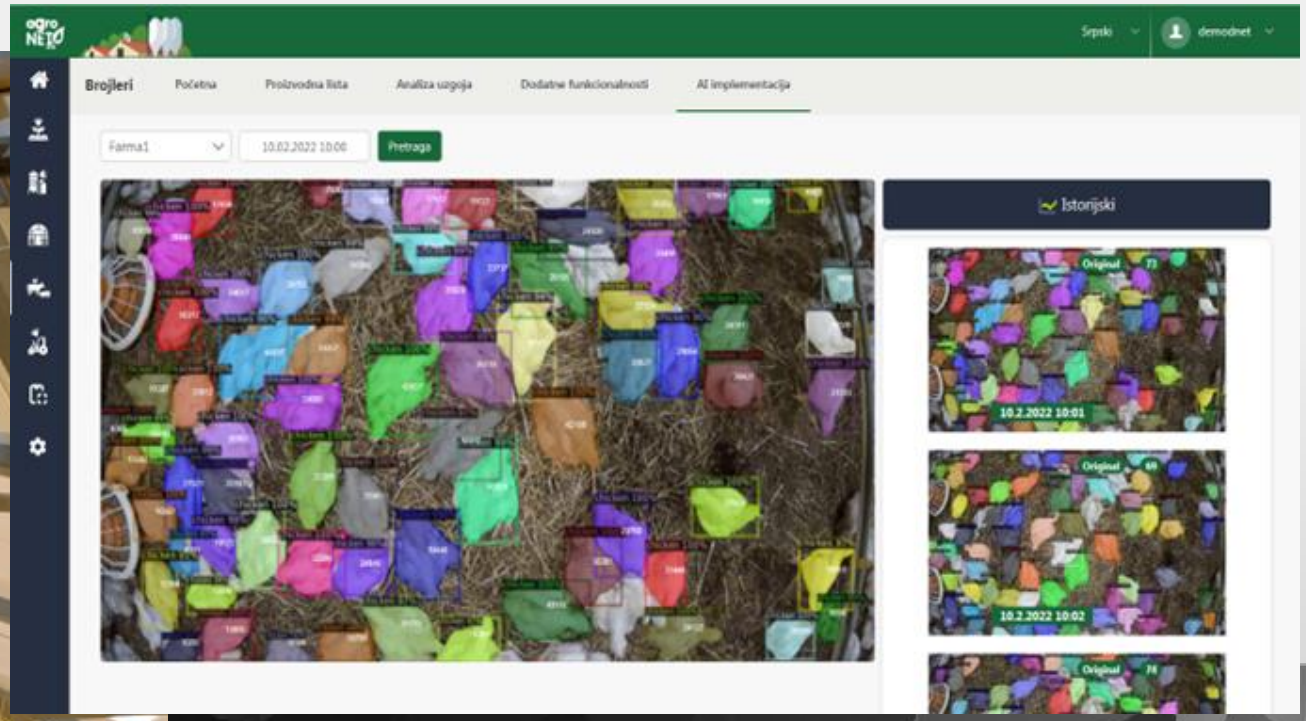
Key outcomes

- Annotated large amount of data (several thousands of images, extended DunavNet dataset)
- Choice of optimal model architecture and parameters for learning/training efficient AI model
- Transferring the model to the IoT/AI edge platform
- Integration with a commercial platform for agriculture agroNet
- Validation with images of end users



Business benefits

- Improved IoT platforms for smart agriculture will benefit the agri-food sector
- Time-saving creation of AI predictive models with HPC
- HPC as a driver of services that offer customized computer vision solutions
- Focus on early disease detection and prevention of disease spread, detection of dead chicks, growth assessment
- Improving productivity, as well as animal welfare
- Better decision making in poultry farm operations

Conclusion

- **Deep learning** can help farmers to improve existing poultry farm management solution.
- Sometimes best model performance is not enough, we need to check model size and prediction time.
- It is possible to integrate good DL model with IoT edge device.
- **HPC** definitely increase chance to automatize experimenting with DL model parameters. HPO becoming very popular and useful today.
- But HPC can be very expensive and can negatively affect on environment / climate change. We need to be aware of that also.
- More details about this project you can find on https://digitalsmart.me/ in the project section.

Project Members and Roles

- DigitalSmart, Montenegro (Technology expert, Coordinator)
- DunavNET, Serbia (Independent software vendor)
- University of Donja Gorica, Montenegro (Domain & HPC expert)
- Radinovic Company, Montenegro (End-user, farm)
- Meso-promet Franca, Montenegro (End-user, farm)

Thanks!

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