Using YOLOv8 for interpreting survey data of high spatial resolution in the visible spectrum range

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1 Introduction

The development of artificial intelligence systems allows the application of a set of technical vision algorithms to solve issues of deciphering high-spatial-resolution optical survey data obtained from various types of drones.

This study aims to design a technology for recognizing objects in logging sites.

Research Objective: developing a technology for automatic interpretation of high spatial resolution aerial survey data in the visible spectrum range.

2 Materials & Methods

Methodology included the following steps:

1. Photographing various plantings, clearings, objects of state forest pathology monitoring from a **Mavic-3** quadcopter.

2. Marking up aerial photography data with the definition of objects to be interpreted in the **Label Studio** program.

3. Training convolutional neural networks using You Only Look Once (YOLO) technology to recognize elements of clearings, tree species, forest drying and degradation.

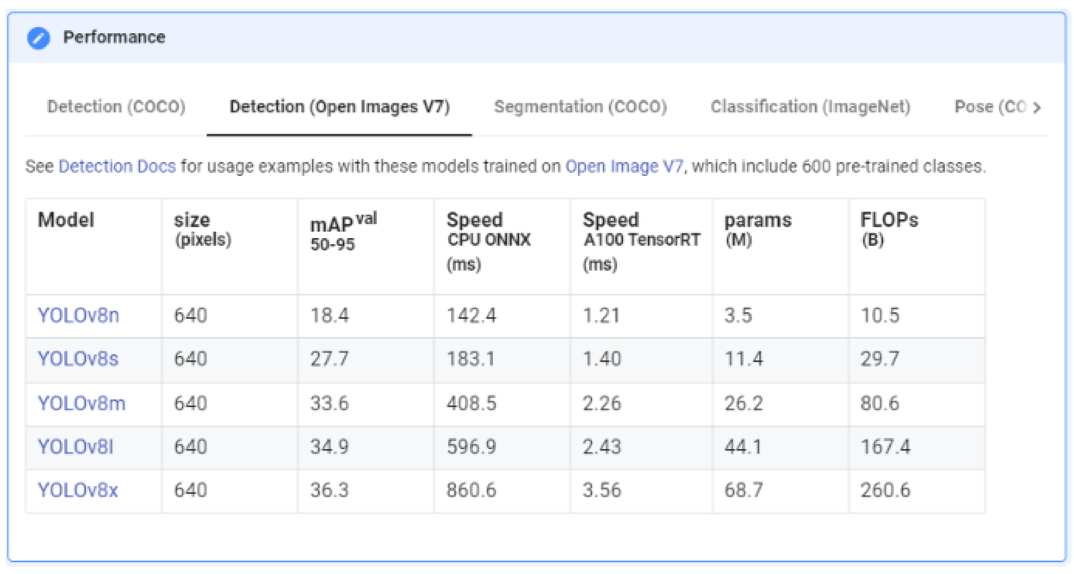
For implementing the work, we used the **You Only Look Once (YOLO)** algorithm. It was developed in 2015 in the research work of Joseph Redmon, Santosh Divvala, Ross Girshick and Ali Farhadi. The Yolo architecture has become a revolution in the field of real-time object detection using deep learning convolutional neural networks.

Data labeling issues were solved with the **Python Label Studio** module, that has a number of advantages: free use, labeling along the object contour, data import into the YOLOv8 environment.

Name of the classes for data labeling

No	Name	Abbreviation
1	Full-length coniferous log	XX
2	Full-length deciduous log	XL
3	Wood Scrap	PO
4	Soil over-watering	PP
5	Soil mineralization	MP
6	Coniferous storage pile	SX
7	Deciduous storage pile	SL
8	Coniferous dead tree stand	CX
9	Windfall coniferous trees	VX
10	Windfall deciduous trees	VL
11	Tree load	PX
12	Deciduous tree crown	KL
14	Coniferous tree crown	KX

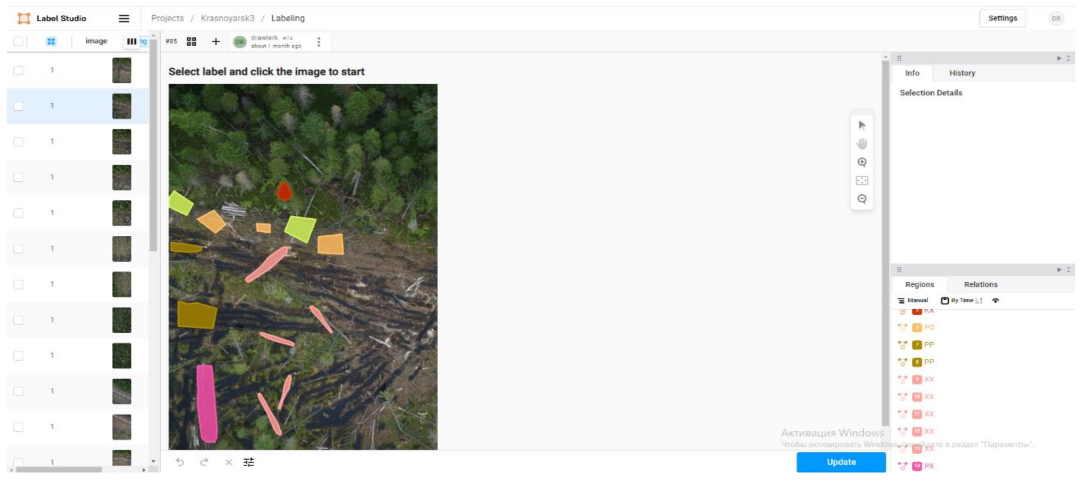
Model choice is an important aspect when using the Yolo v8: **five model options** are offered.


Performance

Detection (COCO) | Detection (Open Images V7) | Segmentation (COCO) | Classification (ImageNet) | Pose (CO

See Detection Docs for usage examples with these models trained on Open Image V7, which include 600 pre-trained classes.

Model	size (pixels)	mAP val 50-95	Speed CPU ONNX (ms)	Speed A100 TensorRT (ms)	params (M)	FLOPs (B)
YOLOv8n	640	18.4	142.4	1.21	3.5	10.5
YOLOv8s	640	27.7	183.1	1.40	11.4	29.7
YOLOv8m	640	33.6	408.5	2.26	26.2	80.6
YOLOv8l	640	34.9	596.9	2.43	44.1	167.4
YOLOv8x	640	36.3	860.6	3.56	68.7	260.6



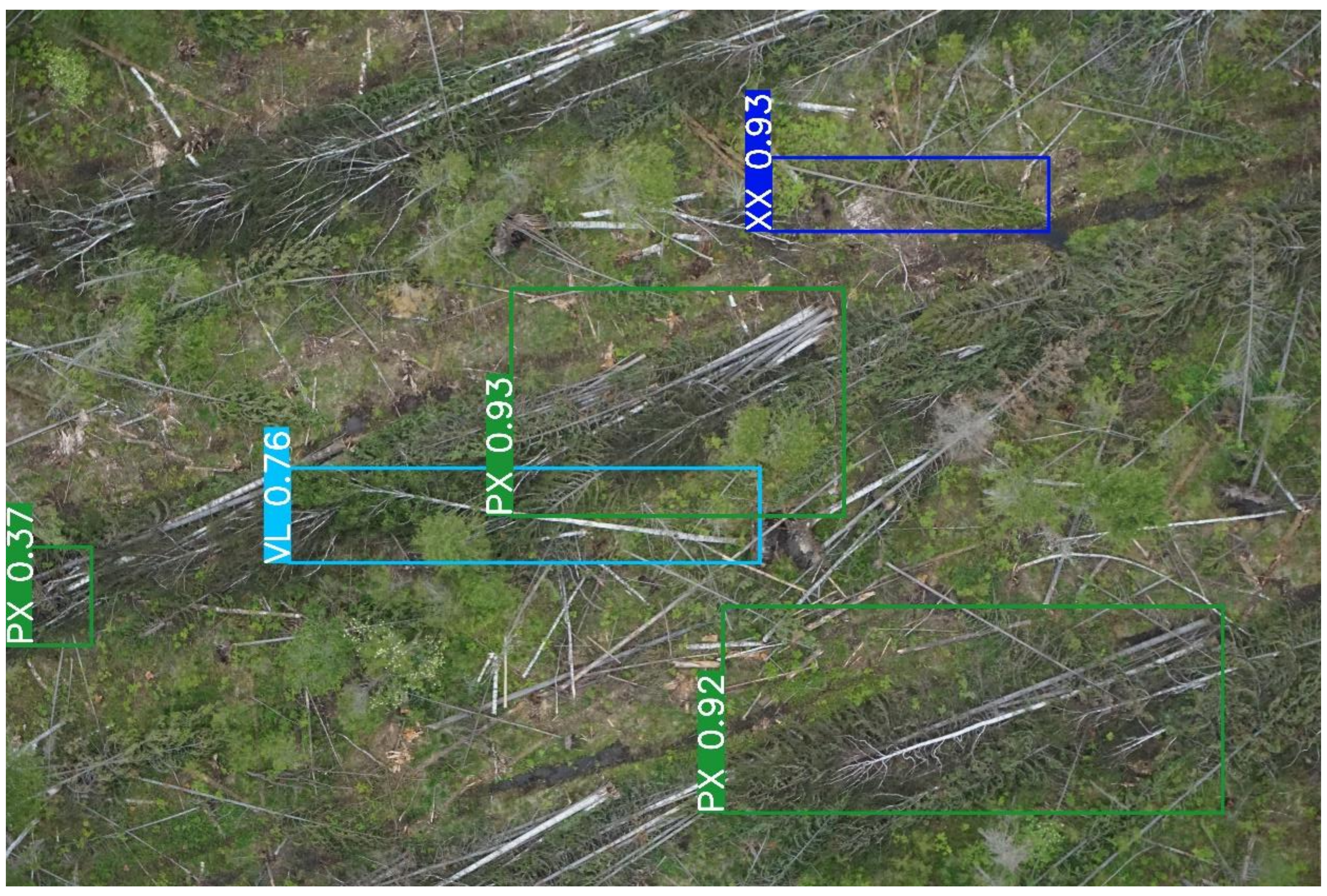
Accuracy and data processing time are decisive factors when choosing models for research tasks. More accurate results are obtained applying the **YOLO v8 extra-large model**.

3 Results

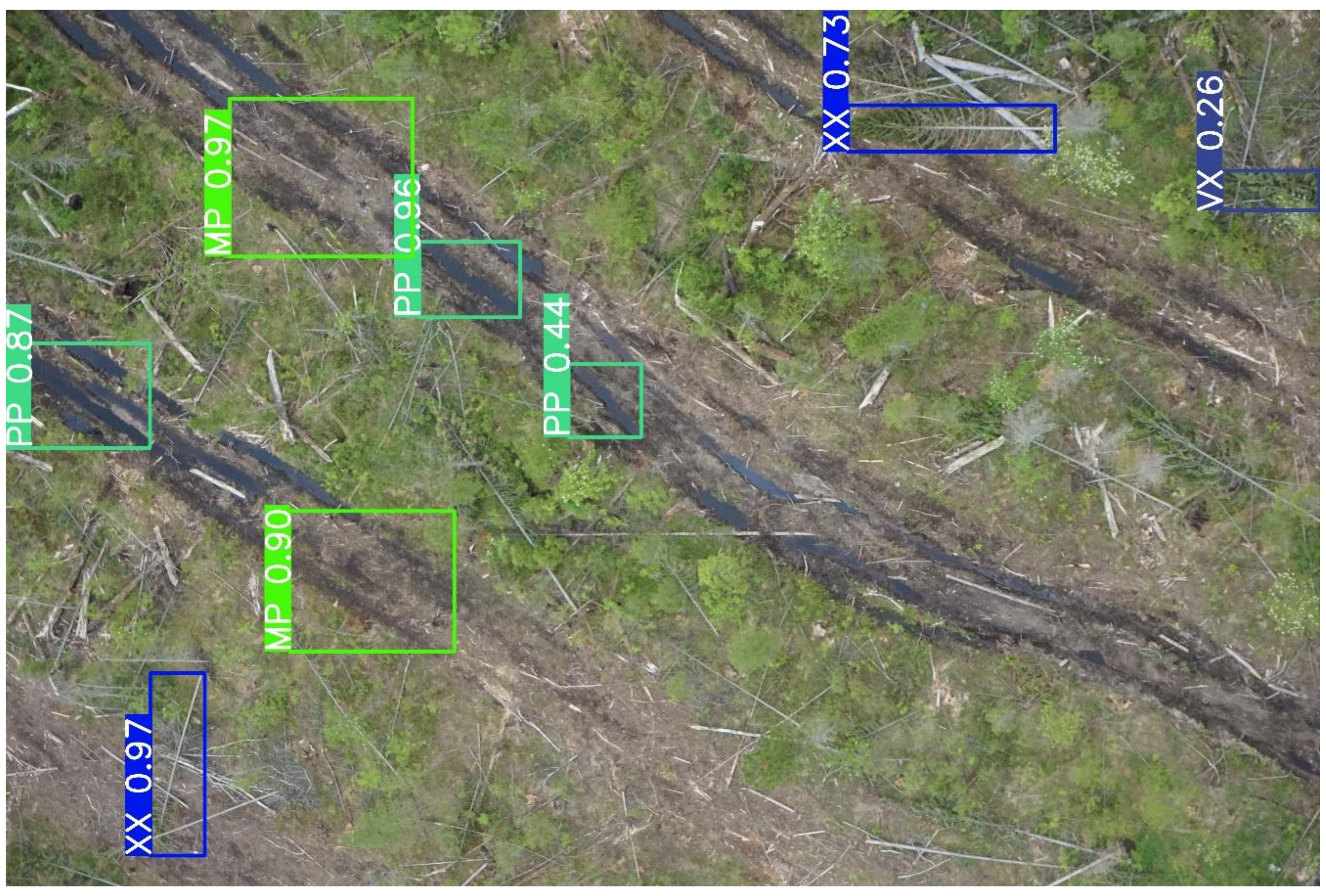
We created an **aerial photography database** of various plantations, clearings, and objects of forest pathology monitoring so as a **database of markings** for various elements of clearings, tree species, and degradation degrees of coniferous and deciduous forest stands.

The data processing results showed that, in general, it is possible to build a computer vision technology based on the YOLOv8 neural network algorithms. Increasing the forecast accuracy is possible by increasing the amount of data by each class during the training process.

The study is based on the results of processing **78 images for training** and **20 images for data validation**. Increasing the model training accuracy is also possible by increasing the image resolution, which requires significant resources from the computer's graphics processor.



Results of aerial photography image analysis to determine **tree loads**, **fallen trees** and **single full-length coniferous logs.**



Results of aerial photography image analysis to determine **single full-length coniferous logs, soil over-watering**, and **windfall coniferous trees.**

The research results can be applied for automatic interpretation of high spatial resolution aerial photography data in the visible spectrum range.