Utilizing YOLOv5 For Rapid Prototyping of Analysis Application

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- Modern OSS (open source software) allow for quick solutions.
- Neural networks, such as YOLO, are effective for automatic image segmentation and recognition.
- YOLOv5 is a popular version with pre-trained models and excellent documentation. It is based on a convolutional neural network (CNN) and has applications in various fields.
- Easy deployment of interfaces for end-users with modern JavaScript Frameworks.
- Utilize available OSS tools and profit by increasing production.

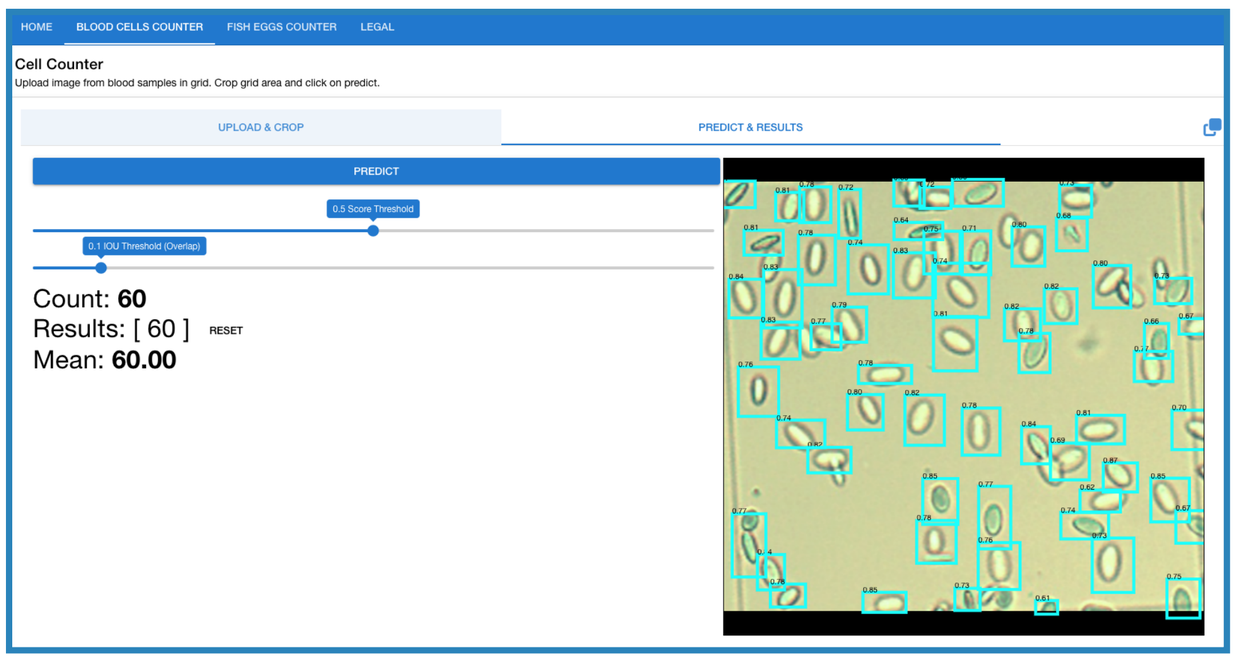

Fig. 1 - Interactive interface to set dynamically IOU threshold for overlapping cases.

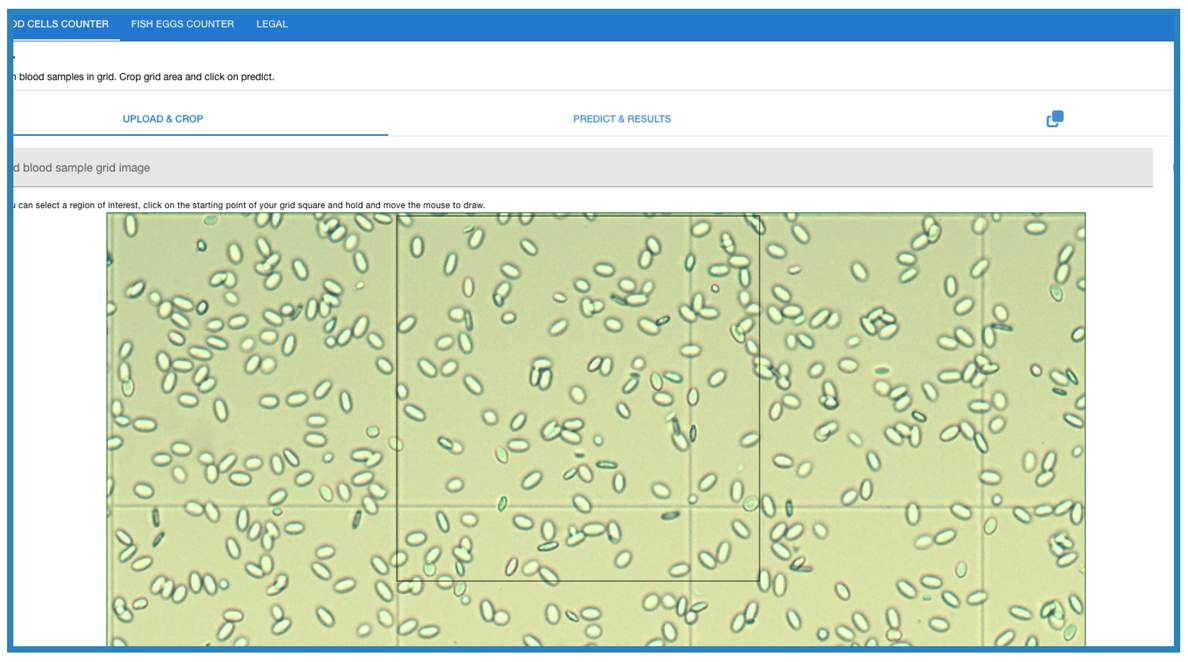

Fig. 2 - Utility tool allows to upload microscope count grid image of blood cells and crop region of interest, directly in the web application.

Use Case: Erythrocyte Cell Count in Fish Species raised at Fishfarm Kreuzstein at the Federal Agency for Water Management (BAW, IGF)

Introduction

- Haematological and biochemical parameters of blood are used to assess fish health and environmental effects.
- Erythrocyte count (RBC) is a commonly used parameter, traditionally analyzed through manual inspection.
- Manual counting of blood cells is time-consuming and prone to errors.
- Alternative methods like flow cytometry are costly and may not be readily available.
- Utilizing object detection technologies like YOLOv5 can automate blood cell counting for fish.

Material & Methods

- Blood was collected from young brown trout.
- Fish were anaesthetized and a small blood sample was collected from the heart ventricle.
- The blood was fixed and pictures were taken at 40-fold magnification using a light microscope.
- Annotated images: 78 training (5487 instances), 17 validation, 9 test.
- Transfer-training on YOLOv5s (300 epochs, 640 image size).
- Transformation of resulting weights to TensorFlow.js for Web-Application.
- End-user interface creation with JavaScript framework VueJs and Quasar.

Results

- MVP (minimal viable product) after three days of work.
- Constant mAP50 of around 0.97 after 100 epochs on validation dataset (Fig. 3).
- Test dataset: mAP50 of 97% (Precision 96%, Recall 94%).
- Trained model weights were successfully deployed inside modern SPA to allow lab workers easy to use interface (Fig. 1-2).
- Public repository and outsourcing of the prediction calculation to the end-users web browser resulted in zero server or hosting expenses.

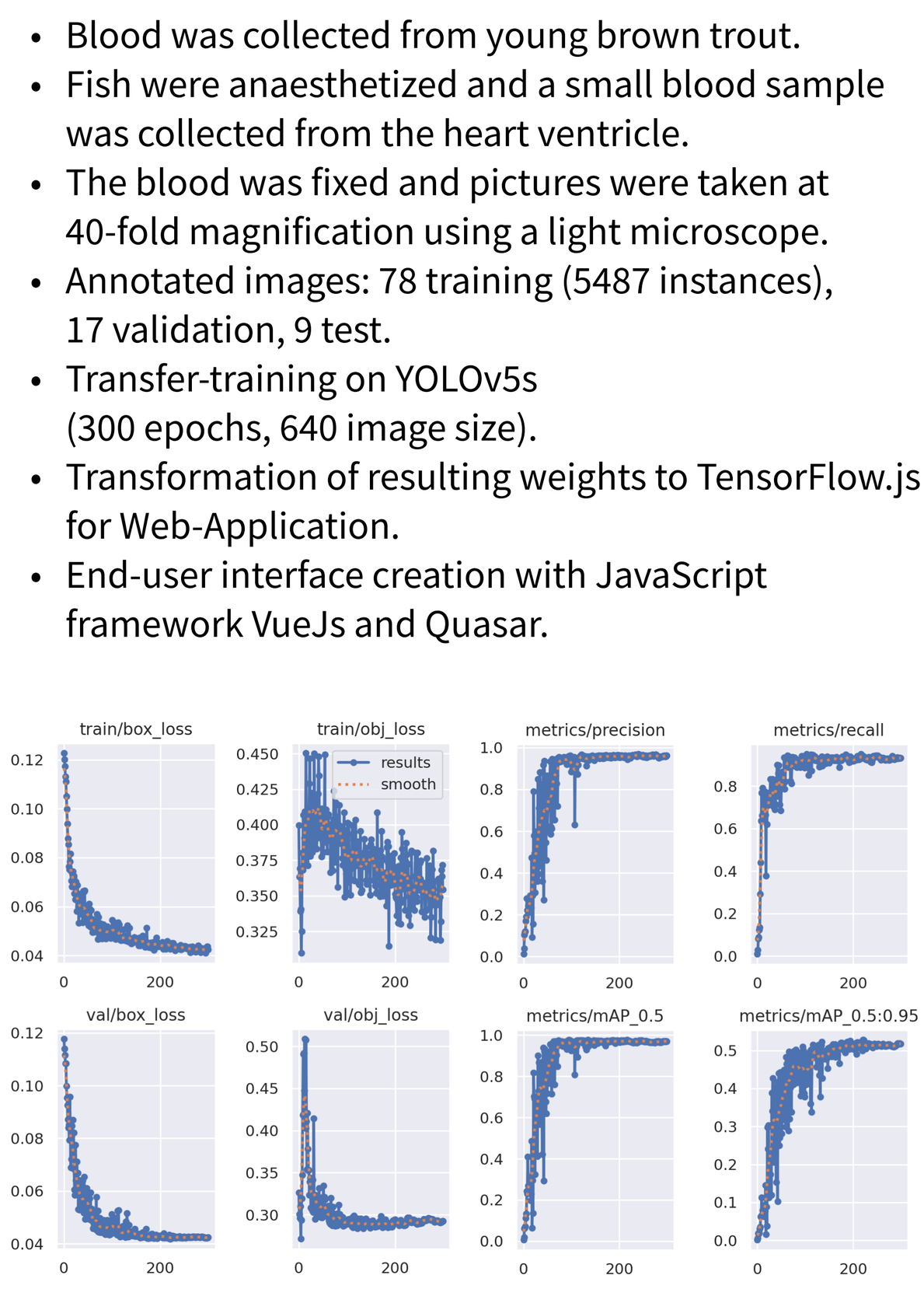

Fig. 3 - Training metrics and results from YoloV5.

Discussion

- The implementation of automatic image recognition enabled automation of workflows in our institute.
- The method utilizes innovative approaches to combine established technologies with modern techniques.
- The applied method is open to further improvements despite its effectiveness, as example no fine-tuning for the model was done.
- Using a neural network for the relatively simple task of blood cell counting may be considered overkill.
- Simpler methods like contour image recognition could potentially yield similar results but with higher susceptibility to errors due to varying lighting conditions during photography.
- Nevertheless, the straightforward application and excellent results, even with varying image quality, convinced us of the effectiveness of the implemented method.
- It allowed us to swiftly establish an efficient system. Visualization of the results allows the end user to handle edge cases like aggregation of cells at one place to take into account for counting.

https://github.com/HannesOberreiter/baw-fish

Federal Agency for Water Management

https://hannesoberreiter.github.io/baw-fish