Computer Vision for Intelligent Pest Detection

AutoEncoder + YOLOv8

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Problem

Pests significantly impact crop health, yield, and quality.

Challenges in Pest Detection:

1. Noise

2. Subtle Differences

Goal

An approach that can accurately identifies pests while overcoming challenges of the noise and subtle differences.

Leverage Computer Vision based pest detection techniques.

Dataset

IP102 YOLO:

19,000 Images

- Collected from internet
- 102 kinds of pests
- Bounding Boxes

Subset used for developing the Proposed approach:

800 Images

- Randomly chosen images from the existing data
- 10 classes
- 80 images per class

10 Classes - "asiatic rice borer", "mole cricket", "aphids", "beet army worm", "flax budworm", "blister beetle", "Lycorma delicatula", "Miridae", "Prodenia litura", “Cicadellidae"

Approach


Input Image
Preprocessing
AutoEncoder
YOLOv8
Detected Pests

Why AutoEncoder?

Two Components

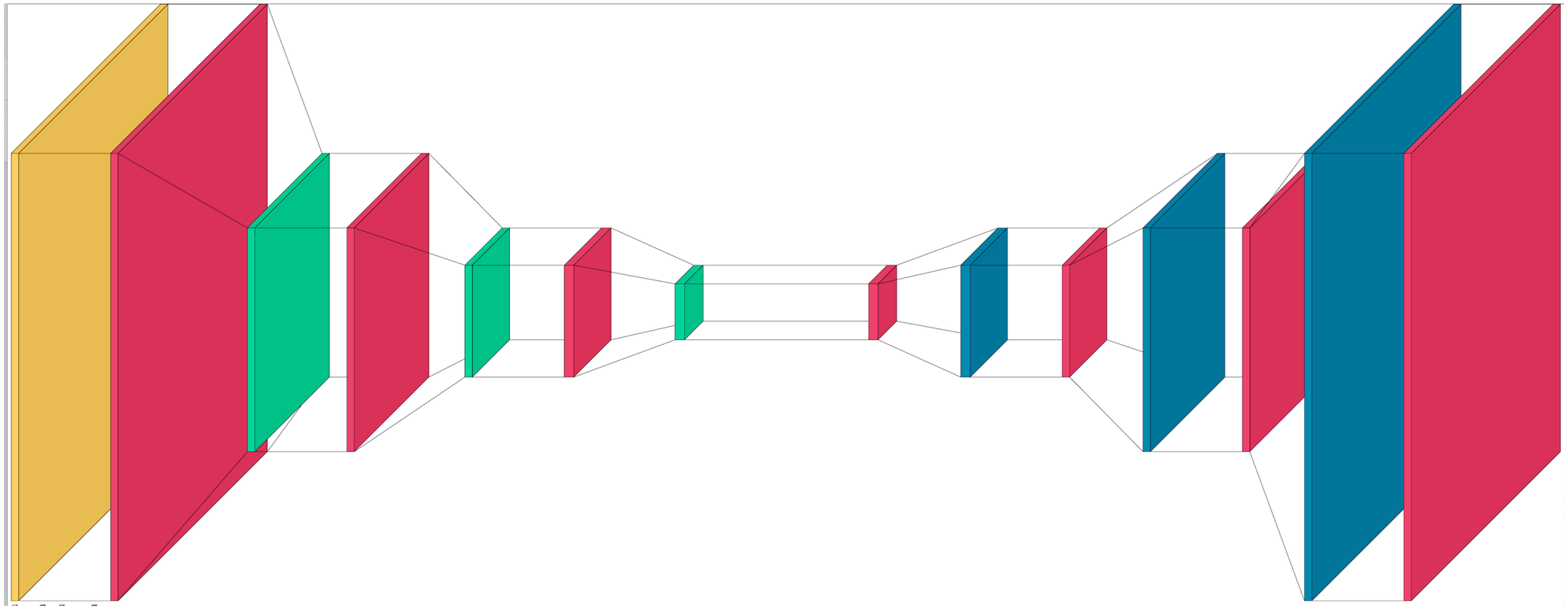
Encoder - Identifies patterns and encodes it in a much smaller dimension

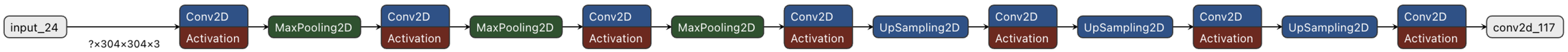
Decoder - Reconstruct the model from the latent representation

Forces AE to learn the important patterns in the image.

Alleviates the problems of Noise and Subtle differences in the images

AutoEncoder





Preprocessing & Learning

Training

- Input image dimensions selection for uniform shapes

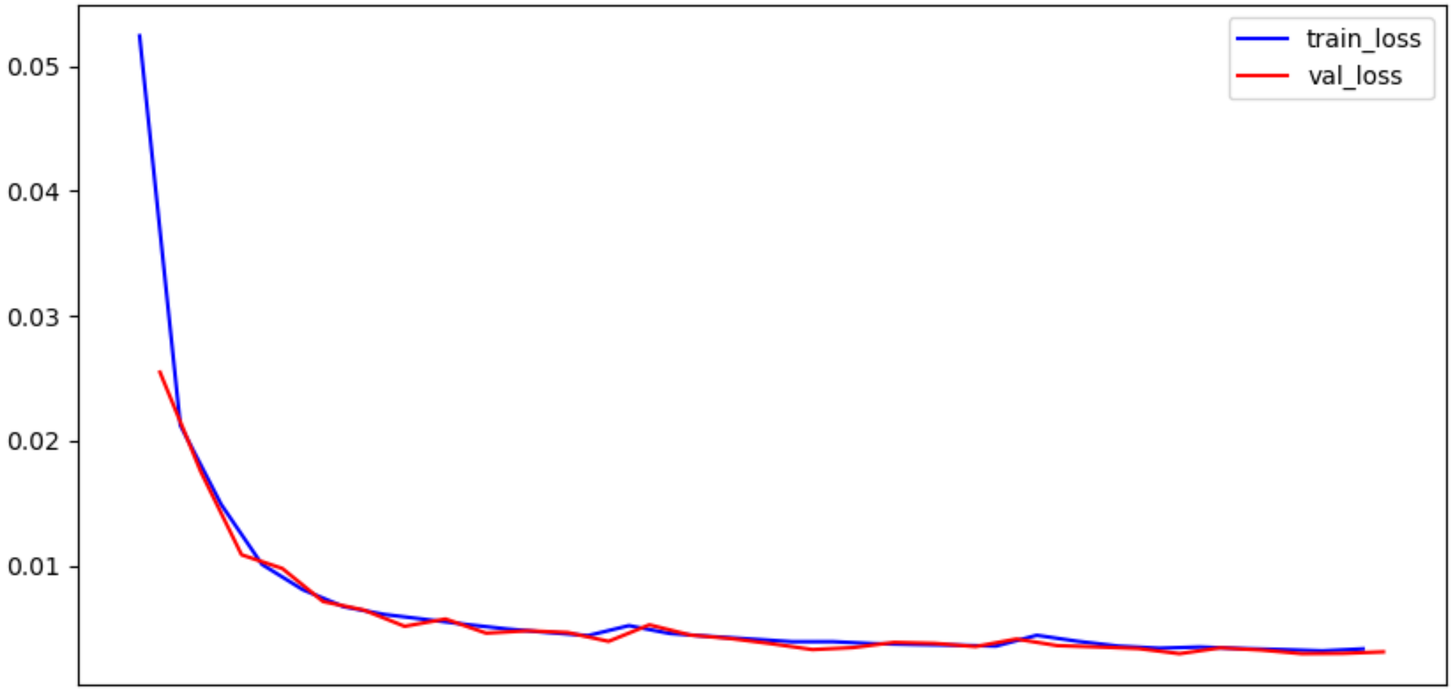
- Add random noise to the image

Learning

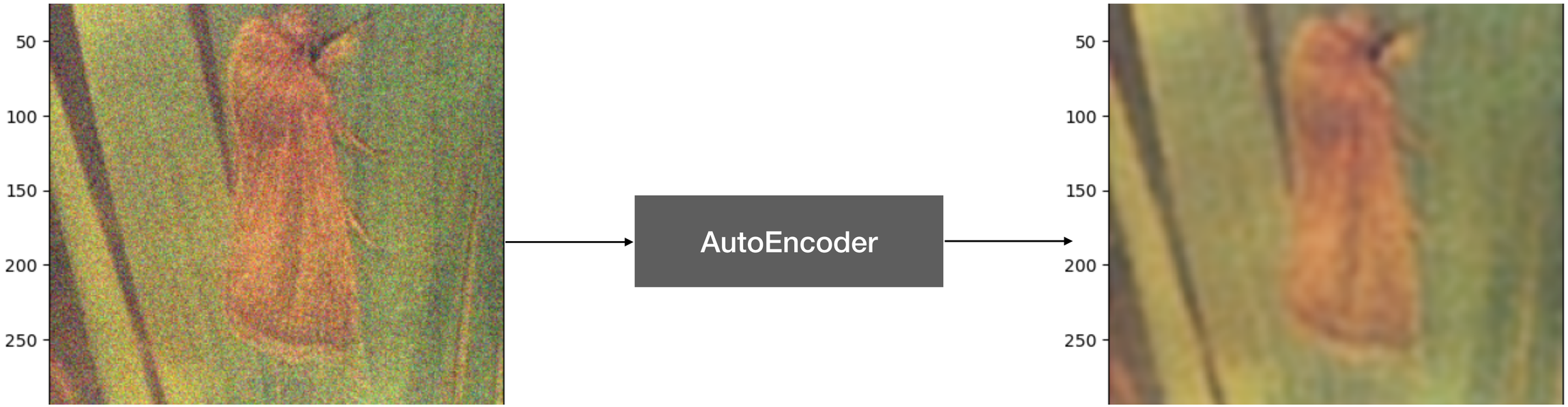
- Keras Sequence and Data Generators

AutoEncoder

MSE on Test: 0.0037



AutoEncoder



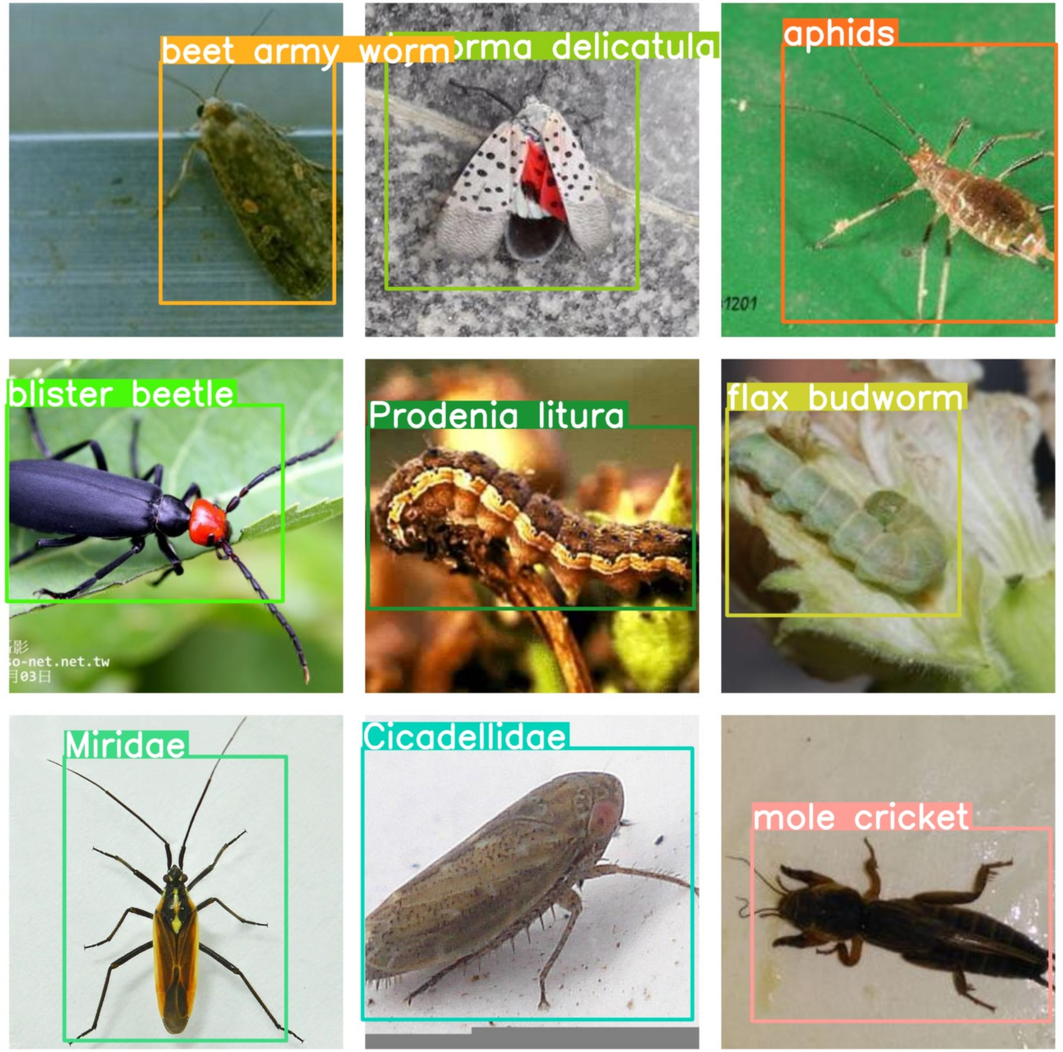
Why YOLOv8?

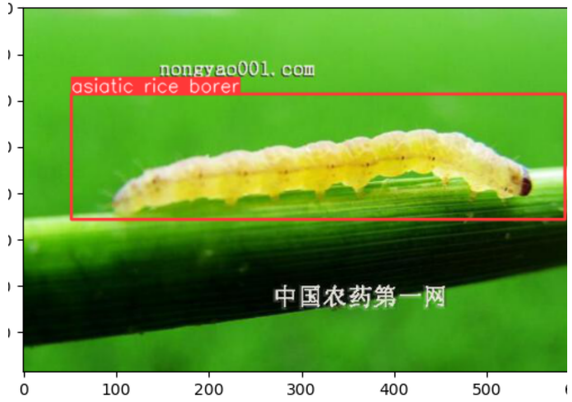
- Single Pass Inference
- Fast & accurate predictions - suitable for real time predictions
- Adapts to the dynamic scale of lesions
- Precise object localization capabilities

YOLOv8

- Backbone - A modified version of CSPDarknet53 for extracting essential features from the input image
- Convolution Blocks - Basic Convolution, C2F, Bottleneck, SPF
- Head - Follows the backbone with multiple conv layers and FC layers and responsible for bounding boxes and class probability predictions

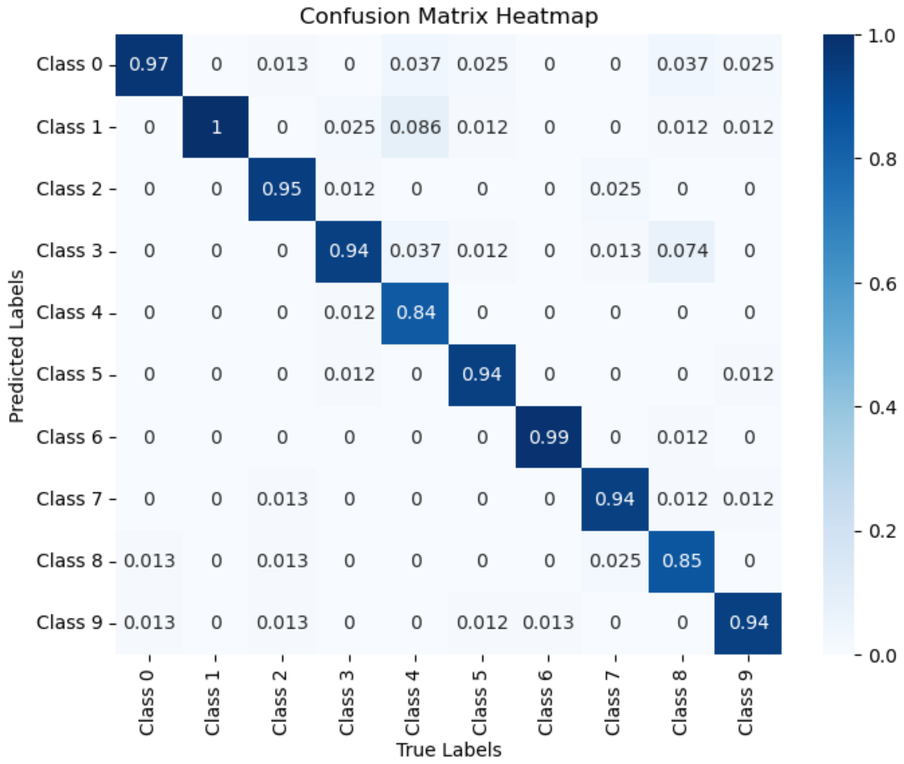
YOLOv8


beet army worm
rma delicatula
aphids
1201
blister beetle
Prodenia litura
flax budworm
Miridae
Cicadellidae
mole cricket


nongyao001.com
asiatic rice borer
中国农药第一网
0
100
200
300
400
500


asiatic rice borer

YOLOv8 Metrics



Accuracy: 93.87%

Precision	Recall
0.88	0.97
0.87	1.0
0.96	0.95
0.87	0.94
0.99	0.84
0.97	0.94
0.99	0.99
0.96	0.94
0.95	0.85
0.95	0.94

Further Steps

- Train on the complete dataset to further enhance the accuracy and prediction capabilities.
- Can be easily deployed on to the embedded devices and can be utilized for predictions in real time.
- Possible to further extend to tasks including image segmentation, in video classification

Demo

Demo the functionality and features of the model developed