WatchEDGE Smart Cameras for Real-Time Wildlife Detection at the Far Edge

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Overview

Wild animals can severely impact crops, making continuous monitoring essential for both farm management and wildlife protection. This work investigates real-time deep-learning–based wildlife detection deployed directly on *far-edge* devices (e.g., GPU-equipped trap cameras) in rural environments, where compute, power, and connectivity are limited.

System architecture and deployment

A custom Visible and IR camera system, powered by a battery pack, is deployed at the far-edge site. The camera connects to local Customer Premises Equipment (CPE) over WLAN via a Wi-Fi extender, and far-edge sites connect to the edge via CPEs over a 4G/5G cellular network. To minimize bandwidth usage, the system transmits *semantic information* (detections/alerts) to a dashboard instead of raw video streams.

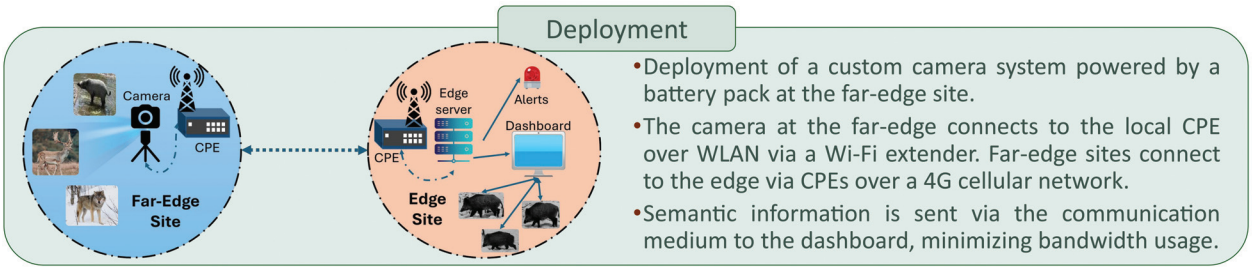

Figure 1: Deployment architecture far-edge camera connection to CPE over WLAN (via Wi-Fi extender), then to the edge/dashboard over 4G/5G.

Augmented deep-learning pipeline

The detection pipeline is based on YOLO and extends the Ultralytics training workflow with additional *on-the-fly multi–color-space* transformations on top of existing augmentations (e.g., mosaic). These heavy linear and non-linear transformations encourage features less tied to raw RGB, improving robustness to camera sensor differences and domain shifts.

Results

Experiments indicate that the augmented models improve robustness, particularly in night-time and adaptive domain scenarios, while remaining suitable for edge-oriented deployment (validated on RTX 3050 laptop GPU and Jetson Orin Nano).

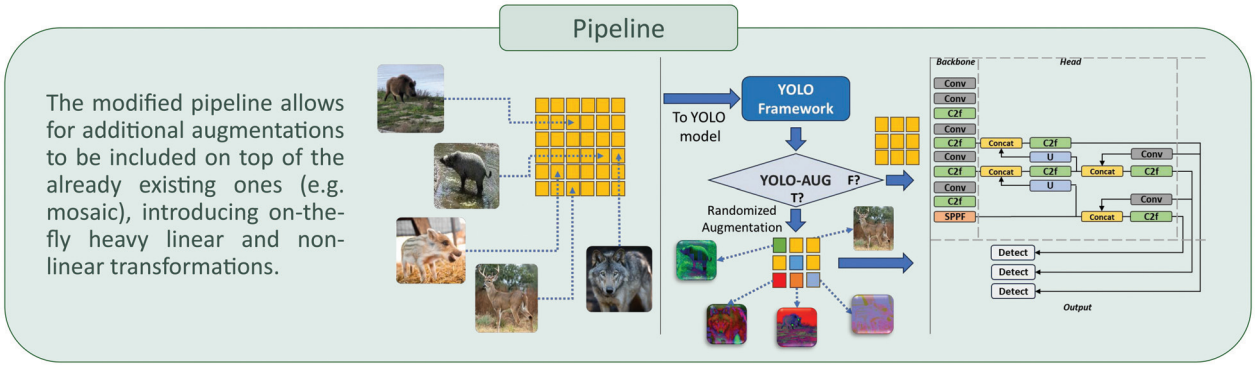

Figure 2: Pipeline excerpted from the poster: drop-in on-the-fly augmentations integrated into the YOLO training workflow.

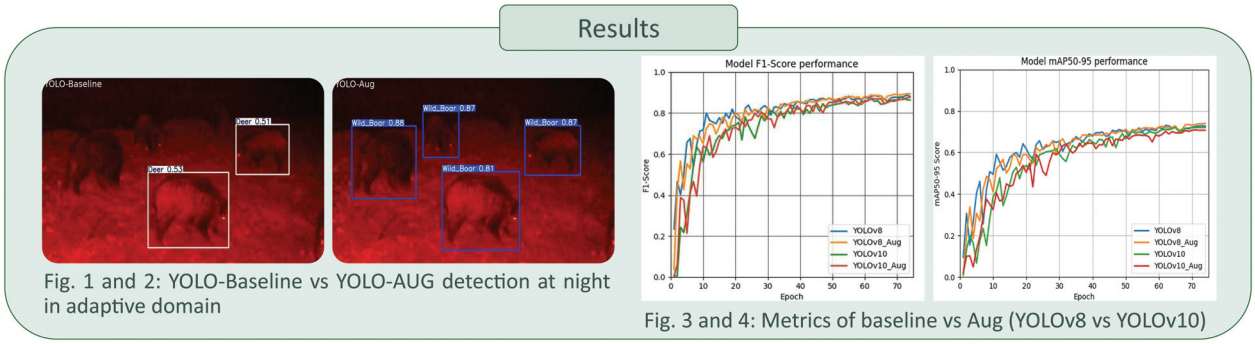

Figure 3: Image processing pipeline of the visible and IR video frames (Fig.1 and Fig. 2) and the compared results for Yolo V8 and Yolo V10

Live demo (demonstrator)

In addition to the poster, we can present a **live demonstrator**:

- a display shows wildlife videos;
- a camera is connected to an **NVIDIA Jetson** device;
- the Jetson runs a real-time pipeline that **detects, localizes, and segments** the wild animal, and overlays the result to a monitor in real time.

Requirements: only a standard power outlet is needed; no additional material is required.

Acknowledgement

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