PROJECT ABSTRACT

# Weed Detection in Crop Fields using YOLO

*A YOLOv8 real-time detector spotting weeds in crop fields on the DeepWeeds dataset, with a detection demo and zone-wise spray map. Delivered built-to-order with report, PPT and viva kit.*

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## 01. Title

Weed Detection in Crop Fields using YOLO

## 02. Introduction / Background

Broadcast herbicide spraying wastes chemical, money and soil health on weed-free ground. Precision agriculture detects exactly where weeds are and sprays only there — which needs real-time detection on a sprayer or drone, exactly what YOLO was designed for. The DeepWeeds dataset (17,509 images, 8 weed species, ground-rover imagery) is the standard benchmark. This project fine-tunes YOLOv8 on it, evaluates with mAP@0.5, and wraps the detector in a demo with a zone-wise spray map quantifying the herbicide saving.

## 03. Problem Statement

Detection tutorials on generic datasets ignore the agricultural deployment story: speed on modest hardware, species-level AP honesty, and the spray/no-spray decision. The project addresses this with the lightweight YOLOv8n for real-time inference, per-species AP analysis, an ONNX/TFLite edge-export path, and a spray-map mode that turns detections into treatment zones.

## 04. Objectives

- Fine-tune YOLOv8n on DeepWeeds at 640×640 with mosaic augmentation.
- Evaluate with mAP@0.5 overall and per-species AP on the test split.
- Build a field-detection demo with boxes, confidences and spray advisories.
- Generate zone-wise spray maps (spray / spot-treat / skip).
- Document the ONNX/TFLite edge-export path.
- Deliver the complete student kit: notebook, weights, demo, report, PPT and viva Q&A.;

## 05. Proposed Methodology

The pipeline has three stages. (1) Data: DeepWeeds in YOLO format across 8 weed species plus the negative class. (2) Training: COCO pre-trained YOLOv8n fine-tuned 150 epochs with mosaic augmentation; best checkpoint on validation mAP. (3) Evaluation and demo: single test evaluation with per-species AP, ONNX export, and wiring to the web demo with the spray-map logic.

## 06. System Architecture / Working

The notebook exports detector weights and species labels. The single-file demo lets the student pick a field capture, runs detection with a scan animation, and renders weed boxes with confidence bars; counts feed the spray advisory. Spray-map mode ranks 8 field

zones by weed density into spray / spot-treat / skip with the herbicide-saving arithmetic. Analytics views show training curves and per-species AP.

## 07. Hardware / Software Requirements

- Python 3, PyTorch, Ultralytics YOLOv8
- OpenCV, NumPy, Matplotlib
- Jupyter Notebook
- DeepWeeds dataset (Olsen et al.)
- HTML5, CSS, JavaScript (demo)
- GPU recommended for training

## 08. Expected Outcomes

- A trained detector with design-target mAP@0.5 of 0.863.
- A field-detection demo with spray advisories and spray map.
- Quantified herbicide-saving estimate on the demo zones.
- A complete report, PPT and viva Q&A; on real-time detection for agriculture.

## 09. Applications

- Teaching real-time object detection and mAP.
- Demonstrating precision-agriculture AI with impact arithmetic.
- Academic study of edge deployment trade-offs.

## 10. Future Scope

- Sprayer-rig integration with GPS-tagged detections.
- Local Indian weed-species fine-tuning.
- Weed growth-stage classification.
- Multi-camera field coverage stitching.