



Student Thesis (Master)

in the context of: **“Deep Learning-based Real-Time Weed Detection”**

BACKGROUND:

In this work, you will develop an efficient real-time weed detection system for precision agriculture using deep learning-based object detection techniques. The focus is on optimizing model performance by leveraging knowledge distillation approach to achieve an optimal balance between accuracy, inference speed, and model size. Additionally, the final model will be deployed on a Jetson Orin Nano device for its applicability in real-world, edge computing environments.

TASK DESCRIPTION:

The following tasks will be undertaken:

- Literature Review:** Examine state-of-the-art deep learning-based object detection methods and knowledge distillation techniques relevant to real-time applications.
- Model Development:** Design, implement, and fine-tune object detection models (e.g., SSD, YOLO, Faster R-CNN, RT-DETR) using teacher-student framework to optimize accuracy and latency.
- Deployment:** Integrate and optimize the final model on a Jetson Orin Nano device, addressing constraints related to memory, and inference latency.
- Evaluation:** Benchmark the developed model using quantitative metrics (e.g., precision, recall, mean average precision, inference time, model size) and compare performance against existing solutions.

METHODS:

- Deep Learning Architectures:** Experiment with established convolutional neural network and transformer-based object detection frameworks, optimizing them for real-time processing.
- Knowledge Distillation:** Utilize teacher-student frameworks to transfer knowledge from larger, complex models to lightweight variants that are suitable for edge deployment.
- Edge Deployment Optimization:** Adapt and fine-tune the chosen model to run efficiently on the Jetson Orin Nano, ensuring real-time inference without sacrificing accuracy.

REQUIREMENTS:

- Understanding of deep learning fundamentals, particularly in computer vision and object detection.
- Proficiency in Python and experience with frameworks such as TensorFlow or PyTorch.
- Preferably with experience or interest in working with edge devices, e.g., NVIDIA Jetson platforms.
- Prior knowledge to knowledge distillation is advantageous.

Contact:

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