Tentative Projects in Computer Vision for Plant Phenotyping.

1. Plant Species Classification

Develop a deep learning model to classify plant species based on leaf, flower, or whole-plant images. Utilize CNNs or Vision Transformers (ViTs) trained on datasets like PlantCLEF. The model will learn to differentiate species based on visual phenotypic traits. Applications include biodiversity monitoring and automated plant identification.

2. Plant Health Status Regression

Build a regression model to predict plant health metrics (e.g., chlorophyll content, nitrogen levels) from RGB or multispectral images. Train the model using labeled datasets containing health scores and corresponding plant images. Techniques include CNN-based feature extraction and regression networks. Useful for precision agriculture to detect stress and optimize treatments.

3. Leaf Disease Detection

Develop an object detection model to identify and classify plant leaf diseases based on visible symptoms. Use datasets like PlantVillage to train YOLO NAS or RT-DETR models for accurate disease localization. The system will detect and classify diseases like rust, blight, or mildew. Helps in early disease detection and reducing crop losses.

4. Plant Segmentation and Trait Analysis

Implement a segmentation model to extract plant structures (e.g., leaves, stems) for automated trait measurement. Utilize U-Net, Mask R-CNN, or SAM to segment plant images into meaningful regions. Extract features like leaf count, size, and shape for phenotypic analysis. Useful for plant growth studies, breeding programs, and automated monitoring.

5. Fruit/Flower Counting and Yield Estimation

Develop an object detection model to count fruits or flowers in plant images for yield estimation. Train on datasets like MinneApple using YOLO or DETR for accurate counting under varying conditions. The model will estimate potential yield based on detected objects. Applications include harvest planning and optimizing resource allocation in agriculture.

6. Growth Stage Classification

Create a classification model to determine plant growth stages (e.g., seedling, vegetative, flowering) using image data. Train CNNs or hybrid models (CNN-LSTM) on labeled datasets capturing different growth phases. The system will assist in tracking plant development over time. Useful for agricultural planning, fertilization schedules, and phenotypic studies.

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