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INFECTED LEAF DETECTION USING YOLO V5 WITH GPT3

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A B S T R A C T :

Plant diseases can severely impact agricultural output if not detected early. This study introduces an automated solution that combines real-time object detection using YOLOv5 with the descriptive capabilities of GPT-3 to identify and describe infected areas on plant leaves. By training the YOLOv5 model on annotated images of diseased leaves, the system can accurately locate infections. Once detection is complete, GPT-3 is used to generate a human-readable summary of the disease symptoms. The combination of visual detection and natural language description aims to assist farmers and agricultural experts in monitoring crop health more efficiently and effectively. The proposed approach shows strong performance in detection accuracy and presents a novel integration of vision and language AI models..

Keywords: YOLOv5, GPT-3, plant disease detection, deep learning, precision agriculture, object detection, leaf infection

Introduction

In agriculture, identifying plant diseases at an early stage is vital to avoid large-scale crop damage. Traditional disease detection methods often rely on visual inspection by experts, which is both time-consuming and sometimes impractical, especially on large farms. With the advancements in deep learning and artificial intelligence, automated systems are now capable of detecting diseases from images with a high level of accuracy.
This project focuses on detecting infected regions on leaves using **YOLOv5**, a popular real-time object detection model, and then generating descriptions of these infections using **GPT-3**, a powerful language generation model. By combining these two technologies, we aim to provide a smart, easy-to-use tool that not only detects disease but also explains it in simple terms.

Literature Review

Various deep learning models like CNNs and object detection frameworks (e.g., SSD, Faster R-CNN) have been used for plant disease detection. Previous research has primarily focused on classification, but few have tackled object localization and natural language interpretation.
Recent advancements like YOLOv5 offer real-time detection with high accuracy and efficiency. GPT-3 has also shown remarkable performance in language generation. This project uniquely integrates both to provide not just detection but descriptive insight.

Methodology

3.1 Dataset Collection and Preprocessing

The dataset includes images of healthy and infected leaves from different plant species, collected from open-access sources like the PlantVillage dataset. Each image was manually annotated to mark the infected areas using tools like Roboflow.
To improve the model's generalization, various data augmentation techniques were applied such as horizontal flipping, brightness/contrast adjustment, rotation, and resizing.

3.2 Training the YOLOv5 Model

We selected YOLOv5s, the smaller and faster variant of YOLOv5, to ensure real-time detection capability. The model was trained using the PyTorch framework. The training setup included:

- Input resolution: 640×640 pixels
- Batch size: 16
- Number of epochs: 100

- Optimizer: SGD with momentum

Model performance was evaluated using precision, recall, and mAP (mean Average Precision).

3.3 Using GPT-3 for Description Generation

After the YOLOv5 model detects the infected regions, the results (bounding boxes and labels) are used to create structured prompts for GPT-3. The prompts describe the visual characteristics of the detected infection and GPT-3 responds with a natural language description. For example:
Prompt: “The detected leaf has small yellow spots scattered along the edges. What kind of disease could this be?”
GPT-3 Output: “The leaf shows signs of leaf spot disease, which typically presents as yellow or brown spots caused by fungal infection. Immediate treatment is advised.”.

3.4 Loading Phase

The final phase of the ETL process involves loading the transformed data into a structured format for further use. In this case, the cleaned data is saved to a CSV file. Key steps in the loading process include:

- Validation: Ensuring the integrity of the transformed data before loading it.
- Saving to CSV: The final data is written to a CSV file, formatted correctly for analysis.
  Future Scalability: The data can easily be loaded into SQL databases or cloud-based storage solutions for more extensive analysis.

Results and Evaluation

The trained YOLOv5 model achieved high accuracy in detecting leaf infections. Performance results are summarized below:

Metric	Value
Precision	93.1%
Recall	91.8%
mAP@0.5	92.4%
Inference Speed	~20 FPS

The model performed consistently well across different types of diseases, such as rust, leaf spot, and blight. GPT-3 was able to generate relevant and understandable descriptions for each case, making the system highly user-friendly for non-technical users.

Discussion

The combined system offers a practical tool for real-time leaf disease monitoring. YOLOv5 ensures quick and accurate detection, while GPT-3 adds a layer of interpretability that bridges the gap between technical outputs and user understanding.
Some limitations of this approach include:

- GPT-3’s reliance on cloud API access, which may hinder offline use
- The need for well-annotated, diverse datasets for training
- GPT-3 might occasionally generate descriptions that are too generic or speculative

Despite these challenges, the system shows promise as a powerful support tool in modern agriculture.

Conclusion

This project presents a novel approach to leaf disease detection by integrating YOLOv5 for identifying infected regions and GPT-3 for explaining those infections. The system performs well in terms of detection accuracy and language generation quality. It provides a useful tool for farmers and agricultural consultants, enabling them to detect and understand plant diseases more efficiently.
Future enhancements may include building a mobile app version, supporting local languages, and using edge computing to allow offline functionality.

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REFERENCES

1. Redmon, J., & Farhadi, A. (2018). YOLOv3: An Incremental Improvement. arXiv:1804.02767
2. Vaswani, A. et al. (2017). Attention Is All You Need. NeurIPS
3. Brown, T. et al. (2020). Language Models Are Few-Shot Learners. arXiv:2005.14165
4. Hughes, D. P., & Salathé, M. (2015). An open access repository of images on plant health to enable the development of mobile disease diagnostics. arXiv:1511.08060