Plant Disease Detection using Deep Learning and Fertilizer Recommendation

IEEE BASE PAPER TITLE:

Plant Leaf Disease Detection Using Ensemble Learning and Explainable AI

IEEE BASE PAPER ABSTRACT:

Plants are integral to the agriculture industry, profoundly impacting a nation's economy and environmental stability, with a significant portion of certain countries' economies reliant on crop production. Much like human health, plants face susceptibility to diseases induced by viruses and bacteria, necessitating careful attention to plant care and disease identification. This study introduces an AI (Artificial Intelligence) model that detects and explains plant diseases through image analysis. The proposed system, distinct from existing detectors, identifies numerous diseases in vegetables and fruits by employing our proposed ensemble learning classifier involving four deep learning models: VGG16, VGG19, ResNet101 V2, and Inception V3, achieving an accuracy exceeding 90%. The reason for using ensemble learning is to obtain accurate predictions. Furthermore, the system sets itself apart by providing explanations for predictions using LIME (Local Interpretable Model-Agnostic Explanations), applied to interpret the predictions of deep learning models. The visualizations generated from multiple methods point to specific pixels' influence on accurate and incorrect predictions, clearly illustrating the model's decision-making process. This technique shows

areas of the image that contributed positively to the model's decision, like key regions where the object of interest was most prominent, and areas that added negative values, where irrelevant or misleading features were present. By exploring these features, we gained insights into how the model interprets and prioritizes different aspects of the image during prediction. The study aims to address existing limitations in plant disease detection, offering a comprehensive solution to enhance agricultural practices, foster economic growth, and contribute to environmental sustainability.

OUR PROPOSED ABSTRACT:

The project "Plant Disease Detection using Deep Learning and Fertilizer Recommendation" aims to enhance agricultural productivity by providing an efficient solution for identifying plant diseases and recommending appropriate fertilizers. Developed using Python for backend processing, Flask as the web framework, and HTML, CSS, and JavaScript for the frontend, this system leverages state-of-the-art deep learning techniques to detect and classify plant leaf diseases with high accuracy.

Two deep learning architectures were utilized: InceptionV3 and MobileNetV2. InceptionV3 achieved a training accuracy of 93.88% and validation accuracy of 90.05%, while MobileNetV2 outperformed with a training accuracy of 98.30% and validation accuracy of 94.38%.

The dataset includes 70,295 images covering 14 plants including apple, blueberry, cherry, Corn (maize), grape, orange, peach, pepper, potato, raspberry, Soybean, squash, strawberry, and tomato and classified into 38 distinct classes, including both healthy and diseased categories.

Upon detecting a disease, the system not only classifies it but also provides appropriate fertilizer recommendations tailored to the specific plant and disease. The platform further enhances user experience by displaying detailed visualizations, including model accuracy and loss charts for both architectures and a class distribution graph for better interpretability of the dataset.

This project serves as a robust tool for farmers and agricultural experts, offering an accurate, user-friendly, and integrated approach to plant disease management, ultimately contributing to sustainable farming practices.

SYSTEM REQUIREMENTS:

HARDWARE REQUIREMENTS:

- System : Pentium i3 Processor.
- Hard Disk : 500 GB.
- Monitor : 15'' LED.
- Input Devices : Keyboard, Mouse.
- Ram : 8 GB.

SOFTWARE REQUIREMENTS:

- Operating System : Windows 10 / 11.
- Coding Language : Python 3.12.0.
- Web Framework : Flask.
- Frontend : HTML, CSS, JavaScript.

REFERENCE:

AMMAR OAD, SYED SHOAIB ABBAS, AMNA ZAFAR, BEENISH AYESHA AKRAM, FENG DONG, MIR SAJJAD HUSSAIN TALPUR, AND MUEEN UDDIN, “Plant Leaf Disease Detection Using Ensemble Learning and Explainable AI”, in IEEE Access, vol. 12, pp. 156038-156049, 2024.