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AgriScan AI: Real-Time Crop Disease Detection for Potato and Tomato

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Abstract

Farming is crucial for humanity's food supply, yet many plant diseases continue to threaten crop yield. This paper presents the AgriScan AI smart system for disease detection in tomato and potato plants by image analysis. The system employs deep learning models like Convolutional Neural Networks for grouping healthy and diseased tomato and potato leaf images based on leaf pictures. We use ResNet and MobileNet with transfer learning to get things working more smoothly. Our service has a simple web interface where users can upload images and get their results instantly. Agriculture is an active field and this solution fits well because it is fast and accurate for on the spot farming decisions. This will help farmers avoid losses and maximize their crop yield.

Keywords: AI; Deep Learning; CNN; Transfer Learning; Precision Farming; Tomato; Potato; Crop Disease Detection.

How to Cite This Article

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Introduction

Agriculture remains one of the world's major industries generating revenue and providing for human consumption. However, the problem of plant diseases has grown to epi-demic proportions. For many crops such as potatoes and tomatoes early blight and late blight are particularly prob-lematic and can infect plants in their early stages of growth. Currently, diseases are identified by trained farming ex-perts and plant scientists on a visual, manual basis. Such a process is, however, very time-consuming and not always feasible at scale, especially for large farms. But thanks to advances in AI, there is now a new, automated solution.

In this paper we present an intelligent system called AgriScan AI that uses deep learning to classify plant dis-eases from leaf images. AgriScan AI will enable farmers and plant care professionals to make informed decisions quickly, accurately, and easily to prevent crop loss.

Literature Survey

Artificial intelligence in agriculture is currently being researched, particularly when it comes to the detection and diagnosis of diseases. Using deep learning in plant disease detection has proven successful, with CNN being one of the most effective models in image classification tasks for agri-culture.

In order to classify plant diseases, a number of well known architectures have been adopted and fine-tuned in-cluding ResNet, VGG and MobileNet. One of the key fac-tors was reducing the training time, and fine-tuning these models on even a small dataset of images produced much better results than starting from scratch.

Although some studies incorporated additional tech-niques such as attention mechanisms and ensemble learn-ing and achieved higher accuracy using CNNs, there are still many limitations.

Lack of diverse and high-quality datasets Achieving ef-fective reproduction of real-world operating environments, especially with respect to lighting and background noise. Limited support for real-time applications on low-end de-vices

Lack of support for real-time applications on low-end hardware.

Many current agricultural information systems have been hampered by ineffectiveness due to complications in usage, thereby failing to assist the farmer to the best of their capability. That is why AgriScan AI employs a much sim-pler and more effective system to assist the farmer.

Methodology And System Architecture

AgriScan AI is a structured chain of processes that enable finding crop diseases in real time for potato and tomato crops and plants. This chain consists of a series of interconnected processes from input data to model application, namely data loading, data cleaning, feature extraction, training and model application and deployment.

Collecting Data

First, you need a huge database of images of leaves from potato and tomato. The database should have many images of healthy leaves as well as of leaves with diseases.

Where the data comes from:

- Public datasets like PlantVillage
- Scanned images and real time images captured with cameras or smartphones

Features of the dataset:

- Different types of seeds: Healthy, Early Blight, Late Blight
- Changes in brightness
- Simple background
- Overlapping leaves

Another crucial principle is that any model you make should generalise well to real life, and that you train it on plenty of data.

Preparing Data

Preprocessing is an important step that makes the input data better and the model work better.

What to do:

- Changing the size of an image: All images are made to be the same size, like 224 × 224 pixels.
- Makes sure that CNN models have the same size of input.
- Normalizing: The values of each pixel are between 0 and 1.

- Helps training go faster by making things come together faster.
- Cutting Down on Noise: Filters are used to get rid of unwanted distortions.
- Makes disease features clearer.

Adding More Data Methods Used:

- Turning
- Zooming
- Change the brightness

Makes the dataset bigger and stops overfitting.

Extracting Features
Convolutional Neural Networks (CNNs) do feature extraction automatically.

How CNN Gets Features:

- Convolution Layers: Find edges, textures, and patterns
- Pooling Layers: Keep important features while lowering dimensionality
- Activation Functions (ReLU): Add non-linearity

Important Features Found:

- Different colors of leaves
- Patterns of spots (symptoms of disease)
- Texture problems

These traits help tell the difference between healthy and sick leaves.

Deep Learning Model Design
Our approach consists of using a deep learning network based on a Convolutional Neural Network (CNN) and a transfer learning approach.

CNN Architecture:

- Input Layer (Image input)
- Convolution + Pooling Layers
- Fully Connected Layers
- Output Layer (Softmax)

Transfer Learning:
Pre-trained models are used to improve performance:

- ResNet: Handles deep networks using skip connections
- MobileNet: Lightweight and suitable for real-time applications

Benefits:

- Faster training
- Higher accuracy
- Reduced need for large datasets.

Model Training
The model is trained using labeled data.

Training Details:

- Loss Function: Categorical Cross-Entropy
- Optimizer: Adam Optimizer
- Batch Size: Typically 32 or 64
- Epochs: 20–50 depending on dataset

Training Process:

- Input images are fed into the model
- Predictions are compared with actual labels
- Error (loss) is calculated

- Weights are updated using backpropagation

We continually re-run the model to find the point at which it starts to overfit, and then taper off the learning rate from that point.

Classification and Prediction
After training, the model is used for classification.

Output Classes:
- Healthy
- Early Blight
- Late Blight

Output Details:
- Predicted class label
- Confidence score (probability)

Example:
Tomato Leaf → Late Blight (Confidence: 97%).

Model Evaluation
We then evaluate the performance of the model on standard objectives.

Metrics:
- Accuracy: Overall correctness
- Precision: Correct positive predictions
- Recall: Ability to detect all positives
- F1-Score: Balance between precision and recall

These metrics ensure the reliability of the system.

Deployment and User Interface
The trained models for analysis can be interactively accessed through a web page.

Technologies Used:
- Flask (Backend)
- HTML/CSS (Frontend)

Workflow:
- User uploads leaf image
- Image is processed by model
- Result is displayed instantly.

Real-Time Processing Capability
The system is designed for real-time usage:
- Fast prediction (< 2 seconds)
- Lightweight models (MobileNet)

Can run on:
- Laptop
- Mobile device
- Cloud platform.

Algorithm

Crop Disease Detection Algorithm

Input: Leaf Image
These images are annotated with the disease class Early Blight / Late Blight / Healthy.
Step 1: Capture or upload leaf image
Step 2: Preprocess image (resize, normalize)
Step 3: Apply CNN for feature extraction

Step 4: Pass features through classification layers
Step 5: Predict disease class
Step 6: Display result with confidence score.

System Architecture

AgriScan AI is a novel system, implemented as a multi-level automated system, in the form of a three-stage pipeline that processes crop leaf images, in real-time, and detects dis-eases using deep learning techniques.

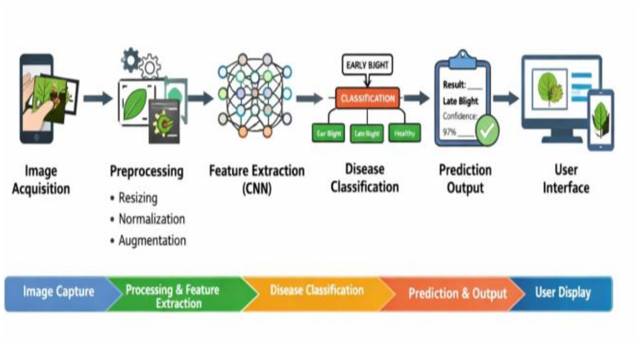

Fig. 1. *Agriscan AI System Architecture*

Application

AgriScan AI has numerous practical applications across different domains in agriculture with the potential to increase efficiency, productivity and sustainability.

Smart Farming :
- Precision agriculture by early diagnosis and targeted treatment.

Real-Time Monitoring :
- Farmers can constantly monitor and respond to the health of their crops.

Mobile-Based Solutions:
- Can be incorporated into mobile applications for field use.

Agricultural Advisory Systems:
- The system can be connected with advisory platforms.
- Suggests treatment after disease detection Provides recommendations for pesticides or fertilizers Supports better farm management.

Research and Development:
- This dataset was built to help with disease analysis and to improve the quality of current AI models.

Government and Agricultural Programs:
- Government agencies can use this system for:
- Monitoring crop health at large scale Early warning systems for disease outbreaks Supporting farmers with digital tools Helps in national agricultural planning.

Supply Chain and Food Industry:
- Ensures quality crops before reaching the market.
- Detects diseased crops early Maintains quality standards Reduces post-harvest losses Improves food safety and supply chain efficiency.

Educational Purposes
Useful for students and institutions:
- Learning AI in agriculture Practical understanding of CNN models Project development Supports academic learning.

Automated Farming Systems
Can be integrated with:
- Drones IoT sensors Smart irrigation systems
- Fully automated smart agriculture system.

Cost Reduction for Farmers
- Reduces need for expert consultation Minimizes crop loss Optimizes pesticide usage Saves money and increases profit.

Result

The working steps of the proposed system are illustrated below:

Fig. 2. *User Interface*

Fig. 3. *Selection Of Crop*

Fig. 4. *Final Result*

Conclusion

AgriScan AI is an advanced real-time crop disease detection system, based on deep learning technology. It can accurately identify several diseases in both potato and tomato crops. The system delivers fast and accurate decision for timely protection of crops and prevention of losses. The proposed system integrates AI to improve the agriculture production, and to enhance sustainable smart agriculture. Future enhancements will be useful.

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