



Deep Learning for Bean Leaf Disease Detection Using Local Image Dataset Sourced from Hugging Face

BACKGROUND & PURPOSE

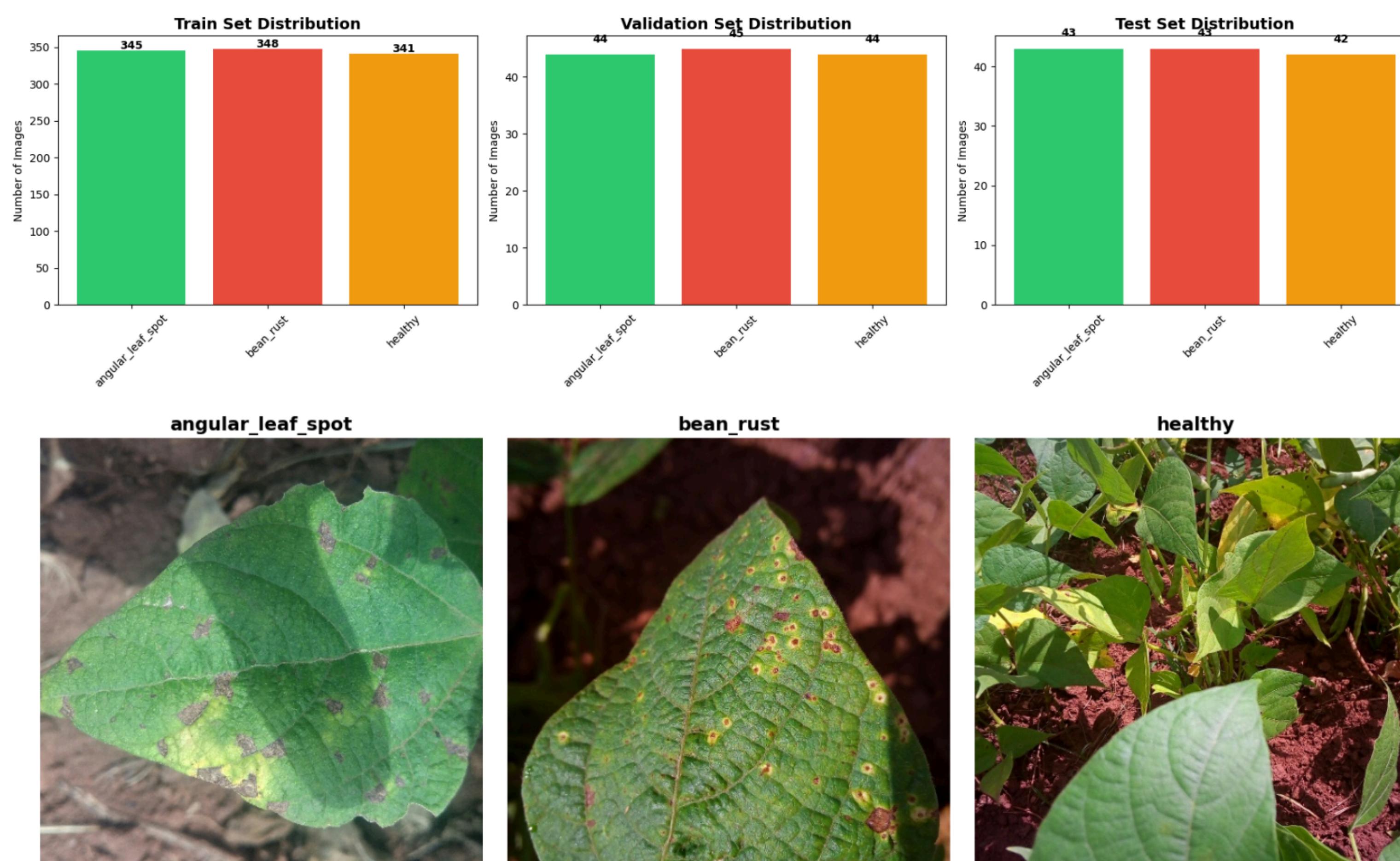
- In Uganda, bean crops—a vital food and income source—are severely threatened by Angular Leaf Spot and Bean Rust. Manual disease identification is slow, error-prone, and often unavailable in remote areas, leading to significant crop loss and food insecurity.
- So this project delivers an automated, image-based deep learning system that instantly classifies bean leaves as healthy or diseased (Angular Leaf Spot or Bean Rust). It provides farmers with a fast, affordable, and accurate diagnostic tool to protect their crops and improve food security.

DATASET DESCRIPTION

- Source: Beans Dataset (Makerere AI Lab/NaCRRI)
- Structure: Train, Validation, Test splits
- Classes: Healthy, Angular Leaf Spot, Bean Rust

EXPLORATORY DATA ANALYSIS

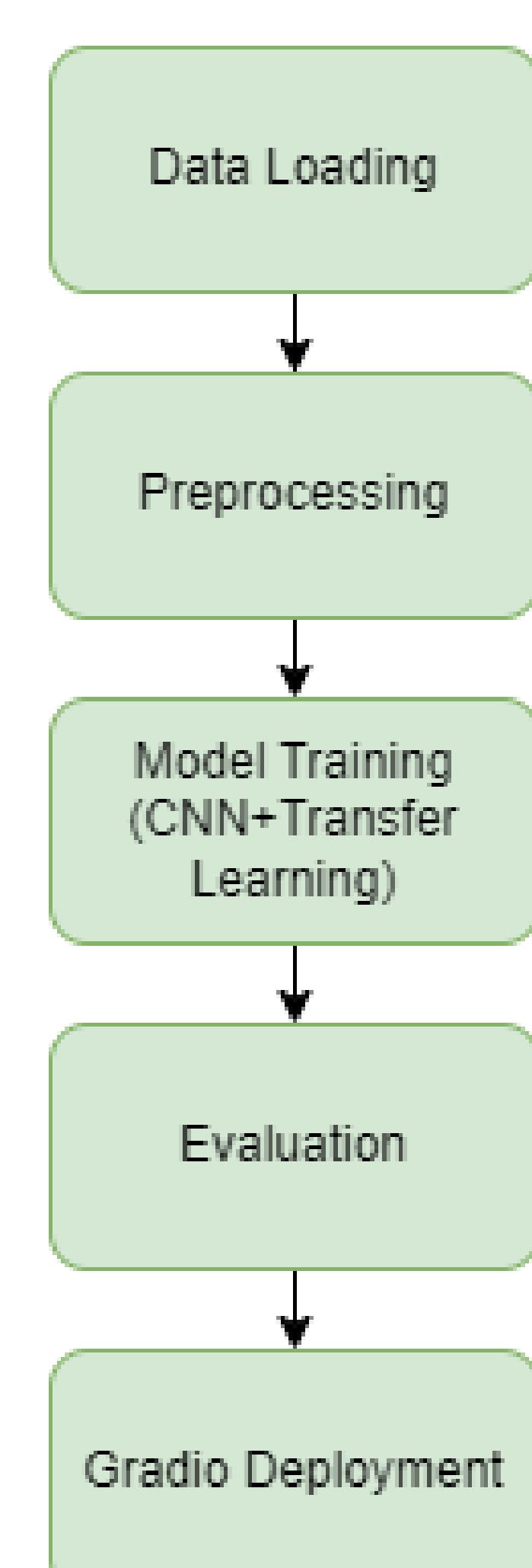
- Balance: Dataset is balanced across all three classes.
- Visual Features: uniform green (Healthy), brown patches (Angular Spot), and orange spots (Bean Rust)



DATA PREPROCESSING & AUGMENTATION

- Preprocessing: Resize (224x224), normalize, convert to tensors
- Augmentation: Random flips, rotations, brightness/contrast changes
- Purpose: Improves generalization to real-world conditions

SYSTEM FLOW



Baseline Model

- A compact Vision Transformer trained solely on our bean dataset. It learns all features from scratch, providing a performance benchmark. This approach is simple but limited by small data size, resulting in lower accuracy.

Transfer Learning Model

- A powerful pre-trained Vision Transformer fine-tuned on our bean data. It leverages prior knowledge from millions of images to achieve high accuracy quickly. This makes it the superior, production-ready solution for real-world disease detection.

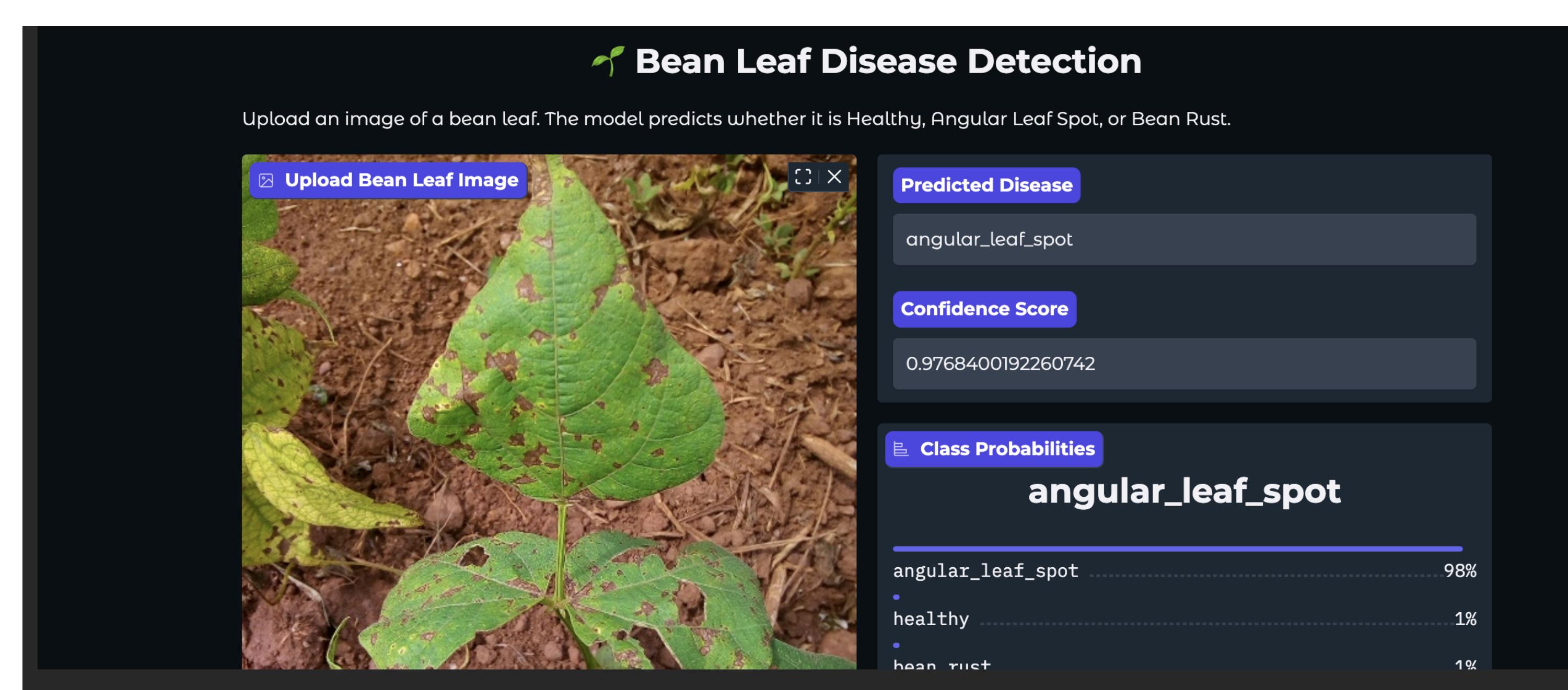
MODEL EVALUATION RESULTS



PRACTICAL APPLICATIONS

- Mobile Scan: Instant disease detection from a leaf photo
- Field Tool: Quick assessments for extension officers
- Surveillance: Tracks outbreaks early
- Benefits: Accurate, fast, farmer-friendly

DEMO



CONCLUSION

Transfer learning model greatly improved accuracy over the baseline model, enabling reliable detection of healthy and diseased bean leaves from simple images. The system is ready for use in agricultural advisory services, with future enhancements including more disease classes, training on real field images, and full mobile deployment.