Smart Agriculture: Deep Learning for Detecting Plant Diseases thru Imaging

1. BUSINESS PROBLEM

Agriculture is the backbone of global food security, yet plant diseases cause up to 40% yield losses annually. Traditional disease detection relies on expert visual inspection, which is time-consuming, costly, and prone to human error. Farmers need an accurate, real-time, and scalable solution to detect diseases early and mitigate crop losses effectively.

3. DATA SCIENCE STACK

- Programming Language: Python
- Frameworks: TensorFlow, PyTorch
- Data Visualization: Matplotlib, Seaborn
- Deep Learning Models: CNN, ResNet, InceptionV3, AlexNet
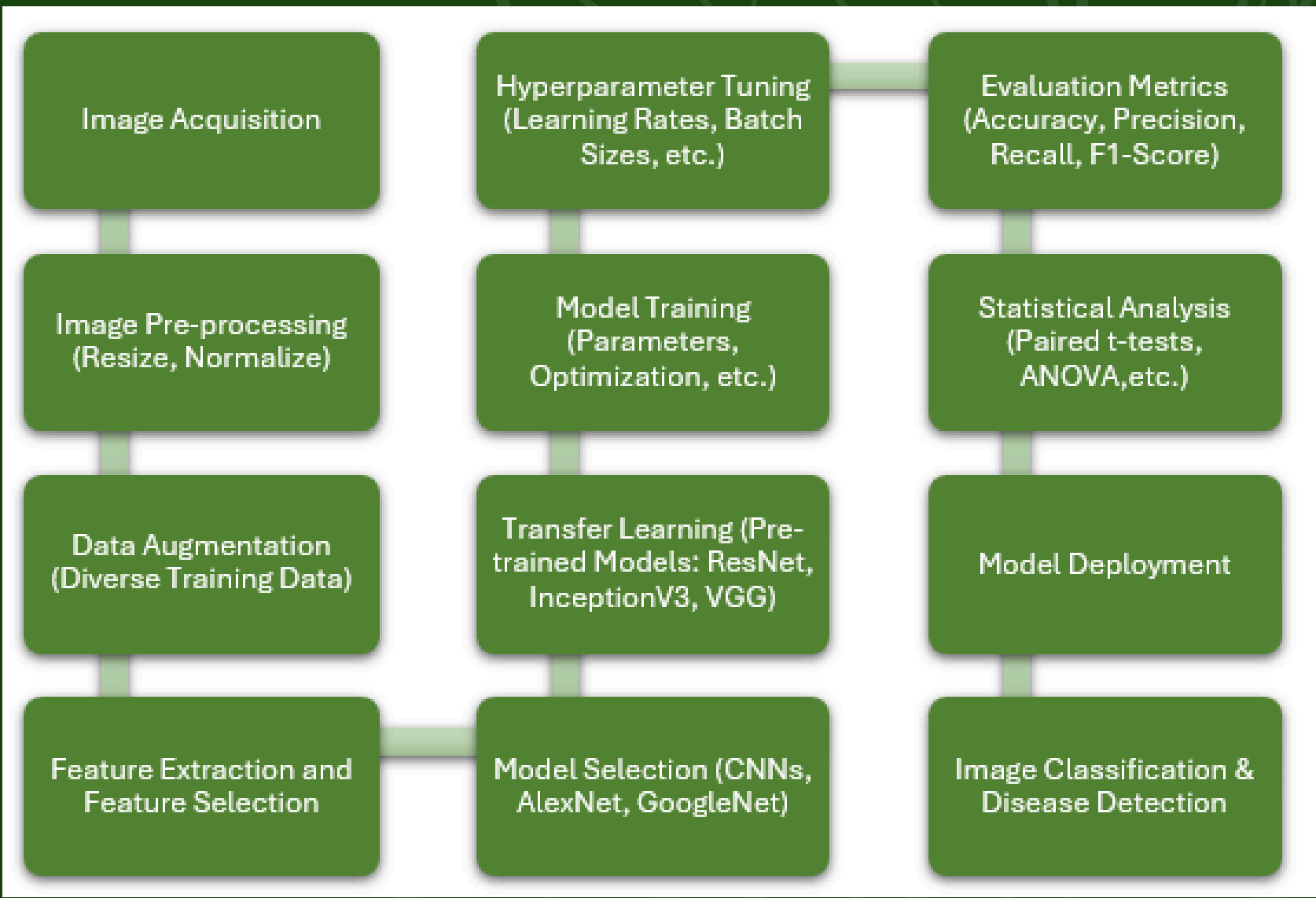- Explainable AI (XAI): Saliency maps, Grad-CAM for interpretability

2. RESEARCH METHODOLOGY

- Image Acquisition
- Image Pre-processing (Resize, Normalize)
- Data Augmentation (Diverse Training Data)
- Feature Extraction and Feature Selection
- Hyperparameter Tuning (Learning Rates, Batch Sizes, etc.)
- Model Training (Parameters, Optimization, etc.)
- Transfer Learning (Pre-trained Models: ResNet, InceptionV3, VGG)
- Model Selection (CNNs, AlexNet, GoogleNet)
- Evaluation Metrics (Accuracy, Precision, Recall, F1-Score)
- Statistical Analysis (Paired t-tests, ANOVA, etc.)
- Model Deployment
- Image Classification & Disease Detection

4. USP OF THE SOLUTION

✓ **EARLY DISEASE DETECTION**
Identifies plant diseases at initial stages, preventing large-scale outbreaks.

✓ **MULTI-MODAL IMAGING**
Utilizes RGB, hyperspectral, and thermal imaging for enhanced accuracy.

✓ **EXPLAINABLE AI**
Provides visual explanations, increasing trust and usability for farmers.

✓ **MOBILE-FRIENDLY & REAL-TIME**
Lightweight models optimized for on-field use with minimal computational power.

✓ **AUTOMATED TREATMENT SUGGESTIONS**
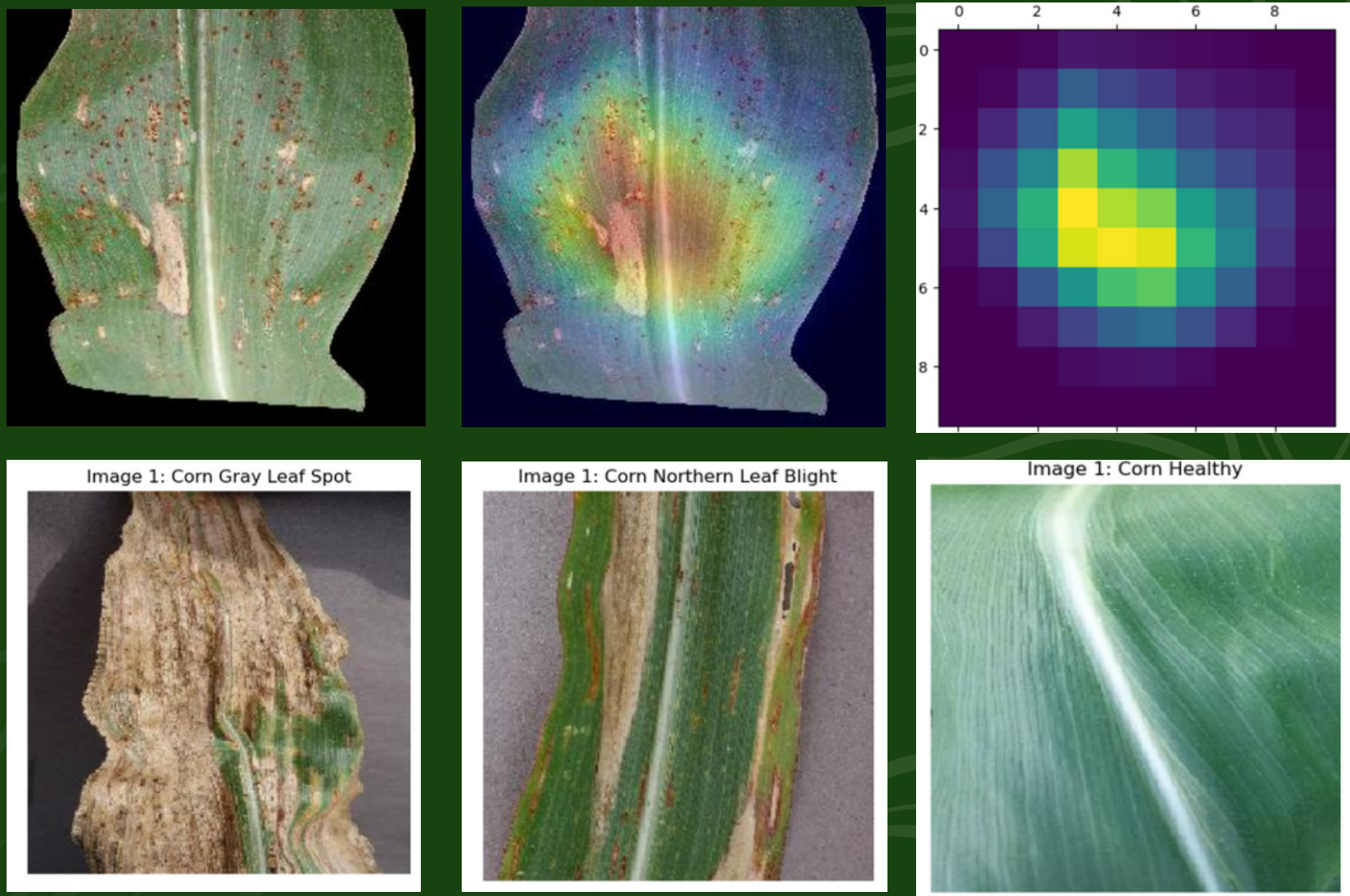Recommends actions based on detected diseases.

AGRO VISION

Image 1: Corn Gray Leaf Spot

Image 1: Corn Northern Leaf Blight

Image 1: Corn Healthy

5. BENEFITS/ROI/VALUE ADDS

- Cost-Effective
- Increased Crop Yield
- Scalability
- Farmer-Friendly Interface
- Sustainability

6. LIMITATIONS

Computational Challenges:
High processing power is required, limiting deployment on low-resource devices.

Multi-Disease Classification:
Limited availability of datasets with multiple diseases in a single plant affects model generalization.

7. FUTURE SCOPE

Integration with IoT & Drones: Enhance data collection and automate disease detection over large farmlands.

Voice-Based AI Assistance: Develop regional language support for greater farmer accessibility.

8. REFERENCES

- Li, L., Zhang, S., & Wang, B. (2021). Plant disease detection and classification by deep learning—a review. IEEE Access, 9, 56683-56698.
- Shoaib, M., Shah, B., Ei-Sappagh, S., Ali, A., Ullah, A., Alenezi, F., ... & Ali, F. (2023). An advanced deep learning models-based plant disease detection: A review of recent research. Frontiers in Plant Science, 14, 1158933.

86092400023 | Faria Khan
86092400034 | Vinit Poojary
86092400038 | Aishwarya Shirsat

M. Sc. Data Science
Mentor: Dr. Yogesh Naik

NMIMS | NILKAMAL SCHOOL OF MATHEMATICS, APPLIED STATISTICS & ANALYTICS