Maize disease Diagnosis

AI-Driven Plant Health Monitoring for African Agriculture

Deep Consulting Team

CONIA Hackathon

July 7-8, 2025

Context : Bridging AI and Agriculture Resilience

Problem Statement

Maize production in Africa faces a **critical diagnostic gap:**

• **Late Disease Detection**: Farmers identify diseases only after visible symptoms appear, that is often too late for intervention.
• **Expertise Shortage**: Lack of agricultural extension officer, which is around 1 per $2,500$ farmers in Cameroon(FAO 2024). Misdiagnosis rates exceed 40% for similar diseases.
•**Economic Devastation**: Spread diseases lead to significant loss.
•**Technology Barriers:** $>$ 70% of smallholders lack smartphones capable of running AI models, unreliable internet and electricity.

Context: Bridging AI and Agriculture Resilience

Proposed Solution

- The primary raechable goal of this hackathon project is to develop a functional prototype that has uses a maize leaf dataset to detect and classify diseases : Maize lethal necrosis (MLN) and maize streak virus (MSV) within 3 days development windows.
- The prototype will employ a machine learning model, a convolutional neural network (CNN) trained on leaf images, to provide real-time disease identification for farmers via a simple and interactive interface.

Dataset Analysis: Exploration

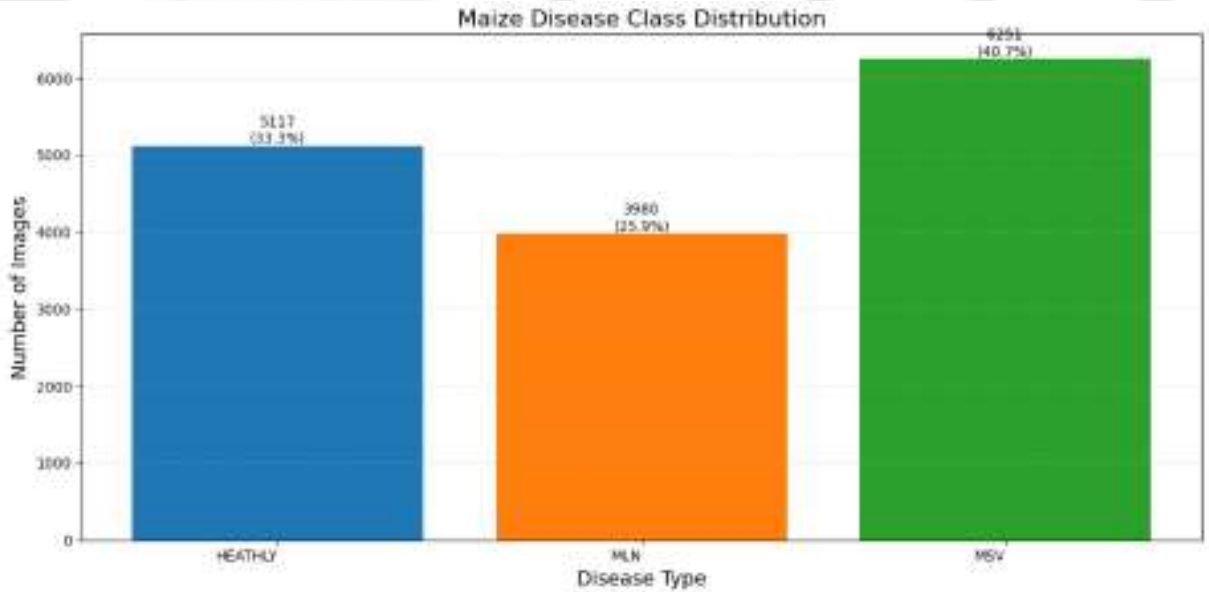
- **Source: Lacuna Maize dataset.**
- **Data Exploration:** The dataset include 3 classes:
  - **Healthy (5,118 images),**:
  - **Maize Lethal Necrosis (MLN, 3,980),**
  - **Maize Streak Virus (MSV, 6,251).**

Figure: sample leaf images

Data Preprocessing

Preprocessing Pipeline

1. **Characteristic extraction:**(done already).
2. **resizing image dimensions** and,
3. **Normalization (0,1)**
4. **Stratified splitting,** in Training, validation and, test sets.
5. **Data augmentation if necessary**



Model Deployment

The processing phase leverages PyTorch to develop and train a Residual Network model (ResNet50), pretrained on ImageNet for maize disease classification. The model take exactly 824 minutes of compilation.
The model is trained for 10 epochs, with metrics (loss, accuracy) as we observe in Figure.

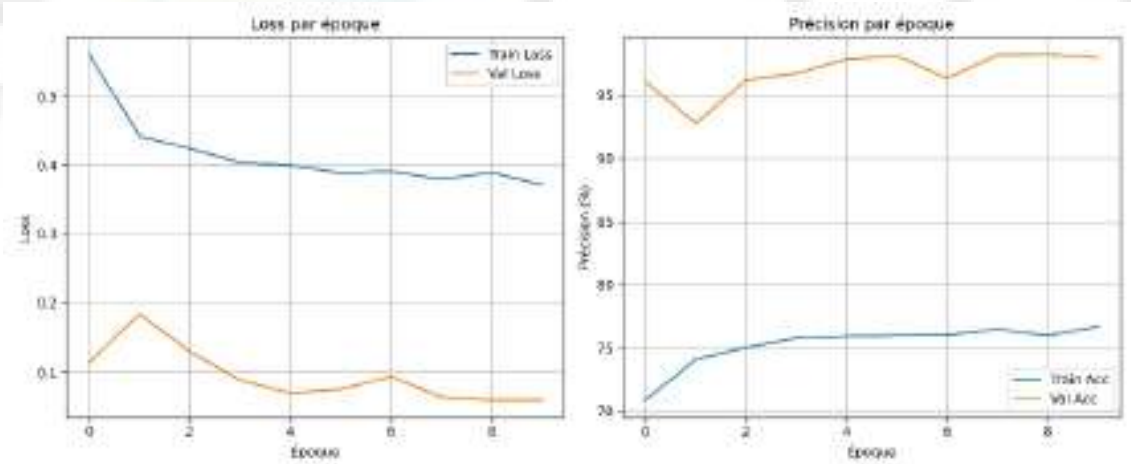


Figure: Loss & accuracy

Results and Findings

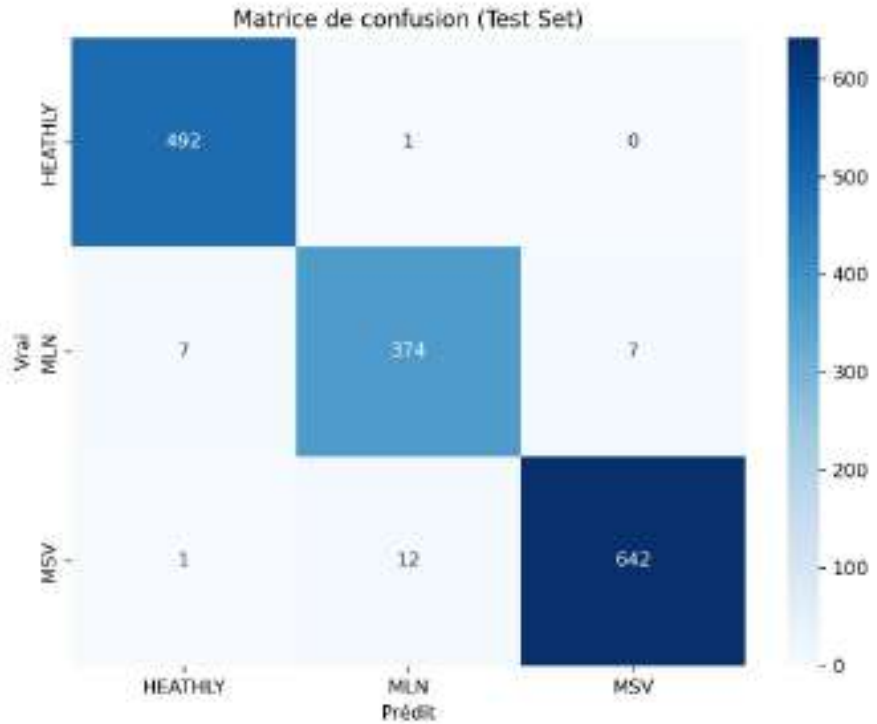
Performance on the test set is evaluated using a confusion matrix and classification report.

Table: Classification Report for Maize Disease Detection

Classification Report	**precision**	**recall**	**f1-score**	**support**
HEATHLY	0.98	1.00	0.99	493
MLN	0.97	0.96	0.97	388
MSV	0.99	0.98	0.98	655
macro avg	0.98	0.98	0.98	1536
weighted avg	0.98	0.98	0.98	1536

Results and Findings

The classification report, based on 1536 test instances, demonstrates a robust model. These scores validate the model's capability to generalize across diverse leaf conditions, despite the dataset's slight class imbalance, thanks to the applied class weighting.



Implement Plan

- The trained model has been saved and integrated into a web application.
- This application features is intuitive interface where users can input data and receive actionable insights.
- Farmers can select between English and French languages,tackling linguistic diversity, and upload images of maize leaves for real-time disease classification.
- Upon uploading an image, the model accurately predicts the class and generates tailored recommendations based on the prediction.
- The application includes an interactive chatbot section, enabling users to discuss disease-related queries or seek further agricultural advice, enhancing engagement and support.

Recommendations and Next Steps

African farmers face catastrophic crop losses from undiagnosed diseases due to **delayed detection**, **expert shortage**, **digital device**.

- **Field Testing and Feedback:** Collaborate with agricultural extension services to pilot the app in real-world conditions, gathering farmer feedback to refine the interface.
- **Long-Term Research:** Pursue funding to develop a comprehensive agricultural AI platform, integrating disease detection with yield prediction and pest management, addressing the broader food security challenges in sub-Saharan Africa.

Impact & Future works

Future Perspectives: Scaling Impact

As immediate next step we count:

- TinyML deployment
- Multimedia diagnosis
- Crop expansion (cassava, cocoa, plaintain, yam disease modules),
- hopefully blockchain integration
- and also combine AI diagnostic with weather patterns.

Challenges & Limitations

Key limitations included:

- Connectivity Issues
- Local Machine Capacity Constraints
- Computational Resource Constraints.

Conclusion

We presented our project on diagnosing maize diseases, a project that combine artificial intelligence and sustainable agriculture. Today, agricultural sector in Sub-Saharan Africa especially in Tanzania is vital. The spread of diseases like maize lethal necrosis and maize streak virus are threaten food security. Traditional method are slow and inaccessible for all.
Nevertheless, we were able to proposed a deep learning-based tool that would help farmers detect early the disease through leaf images.
We thank **CONIA** for this opportunity.

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THANKS FOR YOUR KIND ATTENTION !!!