



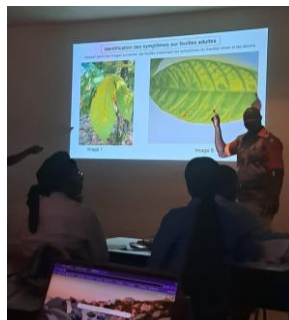
DEEP CACAO

Deep Cacao Project (Deep Farm Côte d'Ivoire) AI Against the Swollen Shoot Virus Disease



DEEP FARM / DEEP COCOA

- Context and project overview
- Objectives and Mission
- Technical Architecture (FARM PLUG)
- AI Models and Target Organs
- Data Lake Infrastructure and Open Source
- IoT Equipment
- Conclusion



- Côte d'Ivoire (CIV) supplies approximately **40% of global cocoa production**.
- The sector contributes between **15% and 20% of the GDP** in CIV and provides livelihoods for about **6 million people** (nearly a quarter of the population).

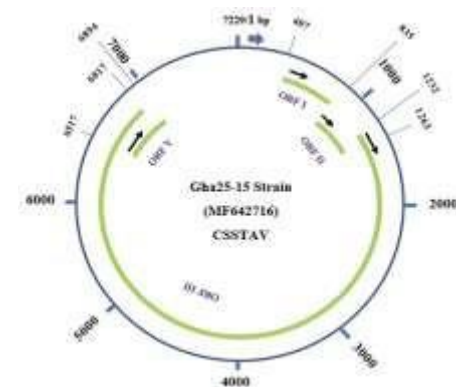
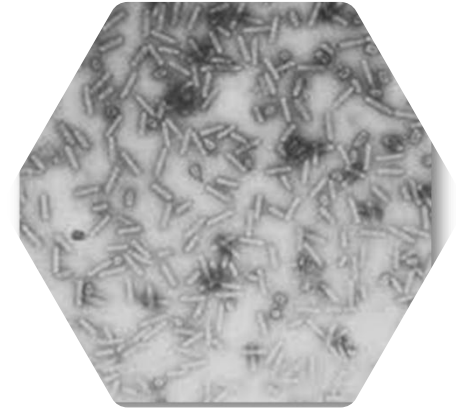
A Major Problem: Cocoa Swollen Shoot Virus Disease (CSSVD)

- The CSSVD is one of the primary biotic health threat, caused by a virus (CSSV).
- It leads to a **50% loss of production in the first year**.
- Transmission occurs mainly via **mealybugs**, with *Formicococcus njalensis* being a major vector.
- Detection is highly difficult because the disease has a **long latency period, up to three years**, before visible symptoms appear.
- Traditional control methods, such as **removal of diseased plants (uprooting)** and barrier plants, are costly, lengthy, and often ineffective.

Objectives and Mission

The mission is to **modernise disease management and improve productivity**, utilizing **IoT technologies, computer vision, artificial intelligence**, and large-scale data management solutions.

- The **early detection of CSSVD symptoms**.
- The **analysis of environmental conditions** conducive to the spread of the CSSVD.



CAPACITY BUILDING & TRAINING



Institut National Polytechnique
Félix HOUPHOUËT-BOIGNY



DATUM
ACADEMY

The project provided practical training to students in:

- CSSVD symptoms recognition
- Digital imaging and field data acquisition
- Geolocation and metadata processing
- Dataset structuring and annotation
- Introduction to machine learning and AI for plant disease detection
- Practical applications of digital agriculture technologies
- More than **40 students** have been trained by both institutions.



- **Field missions** were carried out by students from **INP-HB** and **ESATIC**,
- Over **8,000** high-resolution images of cacao trees have been collected
- Pilot farm location: Loukoukro, Yamoussoukro, CIV

Latitude **N 6°43'6.31668''** and longitude **W 5°22'37.40304''**.

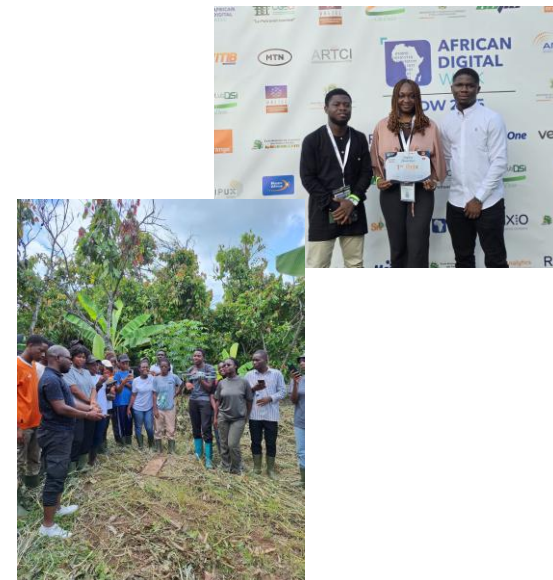


Key Achievements

- Over **40 students trained** in digital agriculture and AI fundamentals
- More than **8,000 geotagged images** collected in cocoa plantation
- Creation of the **first structured national dataset** for CSSVD early detection
- Strong collaborative work between agronomy (INP-HB) and digital technologies and AI (ESATIC)

Perspectives

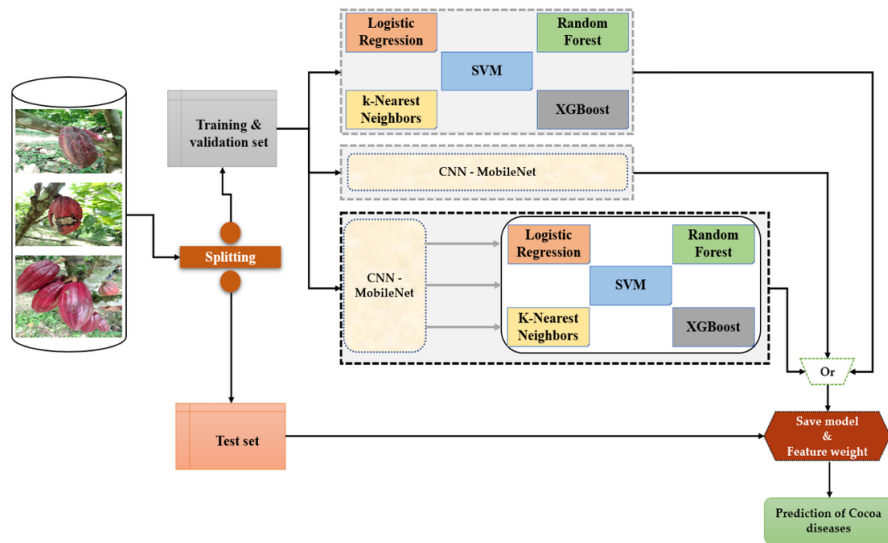
- Expand image collection to more cocoa-producing regions
- Train and validate AI models capable of detecting early symptoms
- Integrate a **Digital Plant Health module** into the agronomy curriculum
- Contribute to a West African **MOOC on Digital Agriculture**



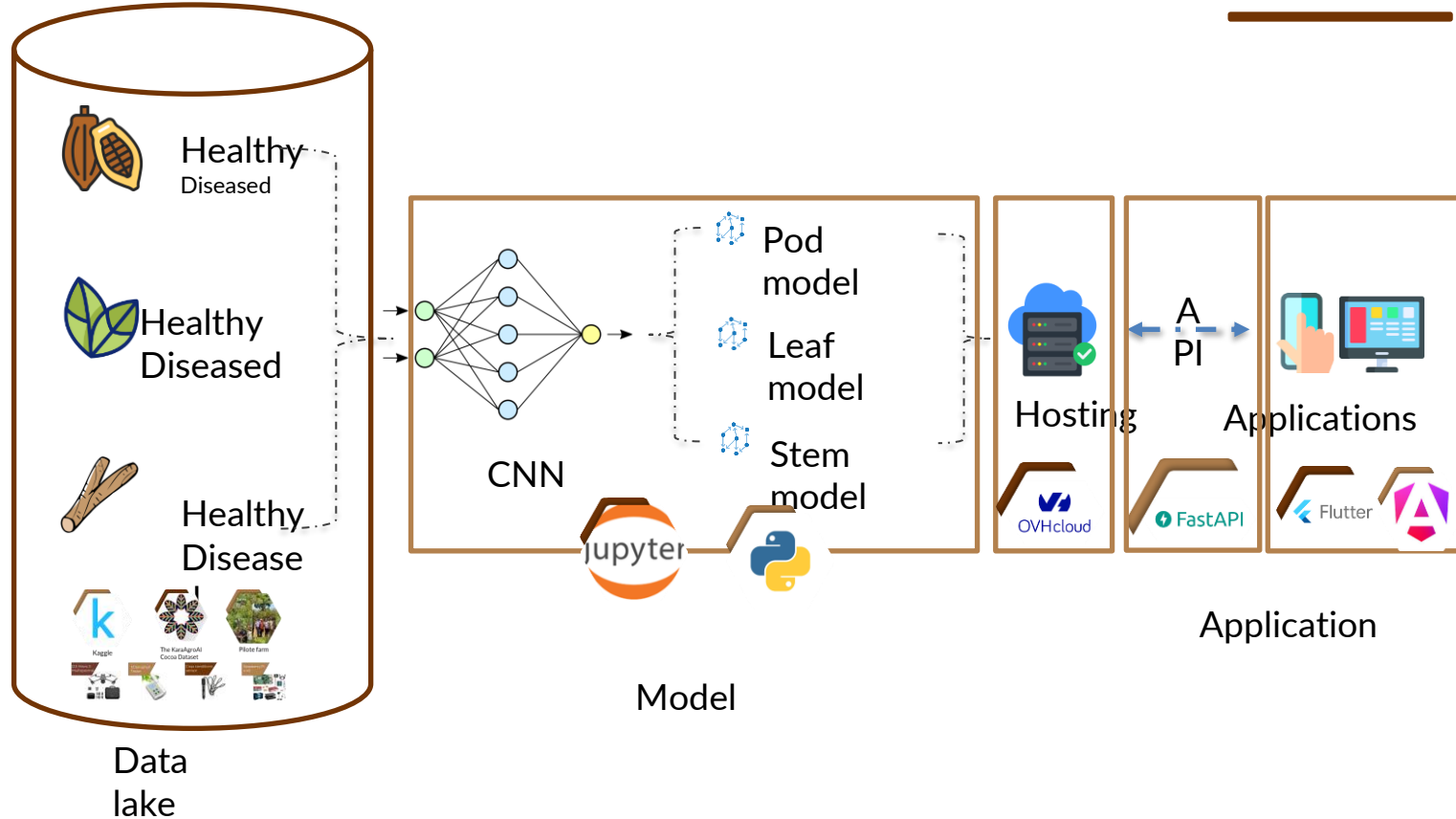
Technical Architecture (FARM PLUG)

The digital solution is based on a modular operating structure called the **FARM PLUG architecture**. The system is built around specialized computer vision models.

- The architecture includes key components such as the **Host**, **API**, **CNN (Convolutional Neural Network)**, and **Applications**.
- It aims to identify and report early
 - symptoms of Swollen Shoot on leaves, pods, and stems.



AI Models and Target Organs



A **Data Lake** is utilized for **centralized, flexible, and scalable storage** of all collected data (images, sensor data, historical information).

- **Hadoop** is used for distributed storage of massive data (HDFS), and **Spark** for real-time and batch data processing, including AI model training.
- **Elasticsearch** provides a powerful search and indexing engine for rapid data retrieval.
- **Kafka** is envisioned for managing real-time data flows from IoT sensors.
- Data is structured in layers: **raw, cleaned, analytical, and modeled for AI**.

IoT Equipment

IoT Equipment:

Multispectral Drone (DJI Mavic 3 Multispectral): Couples an RGB camera with a multispectral camera to scan and analyze crop growth.

Kit Raspberry Pi 4: Used for IoT projects, prototyping, and field data processing.

The pilot farm:

- **Location:** Loukoukro, Yamoussoukro, CIV.
- **Coordinates:** Latitude **N 6°43'6.31668''** and longitude **W 5°22'37.40304''**.



Conclusion

- The Deep Farm / Deep Cacao project has come to an end with an overall positive outcome: all major objectives have been achieved.
- The results obtained—skills, digital tools, databases, and mobile application—constitute a lasting legacy for ESATIC, INPHB, and all partners.
- **Field missions** were carried out by students from **INP-HB** and **ESATIC** in cocoa plantation,
- Over **8,000** high-resolution images of cacao trees have been collected,
- An **AI model** has been developed for the early detection of Cocoa Swollen Shoot Virus,
- A **mobile application** has been developed that allows the AI model to be applied.

Demonstration



https://www.youtube.com/watch?v=sJ3lwOlsMg&list=PLoKO2riHgXGJ4O6yaZhViRB_wRuUIULVV

DEEP CACAO

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