

PRACTICE ABSTRACT n° 28

Smart storage system for onions using ventilation system and remotely monitoring by using a mobile App

Authors: Nouredine Mokhtari, Rachid Lahali – Ecole Nationale d'Agriculture – Meknes (ENAM)

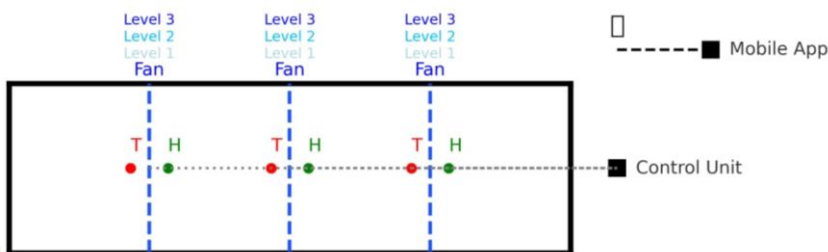
Post-harvest losses in onion storage remain a significant challenge for farmers and agribusinesses, often leading to economic losses and reduced food security. The **Intelligent Onion Storage Prototype** is designed to address this issue by integrating a **smart ventilation system within metal silos**, combined with a **mobile application for remote monitoring and control**. This prototype employs **IoT-enabled sensors** to continuously monitor critical storage parameters such as **temperature, humidity, and airflow**, enabling automated fan control for optimal environmental conditions.

The system is complemented by a **mobile application**, allowing farmers to **remotely monitor real-time storage conditions** and **control the ventilation system** from anywhere. The app provides:

- **Live Data Visualization** – Displays temperature, humidity, and airflow levels.
- **Automated & Manual Fan Control** – Users can adjust ventilation settings remotely or allow the system to function autonomously.
- **Predictive Alerts & Notifications** – Sends real-time alerts for critical storage conditions.
- **Historical Data & Analytics** – Helps users track trends and improve storage strategies.

The objective was to find the **best technological solutions using a smart storage system to reduce onion storage losses in terms of quantity and quality** using smart storage silos.

Top-Down Schematic of onion storage silo with Wi-Fi connection and mobile App.



Each silo (6*1*1m) is equipped with 3 sensors with 3 depth levels to inform the system of the temperature and humidity status inside. Every sensor is fixed on a 1.2m rod, which allows it to be inserted into the pile of onions. It is equipped with 3 separate fans at 1.5m of interval. The system continuously collects (1 minute) the temperature and humidity measurements and sends them to the data server.

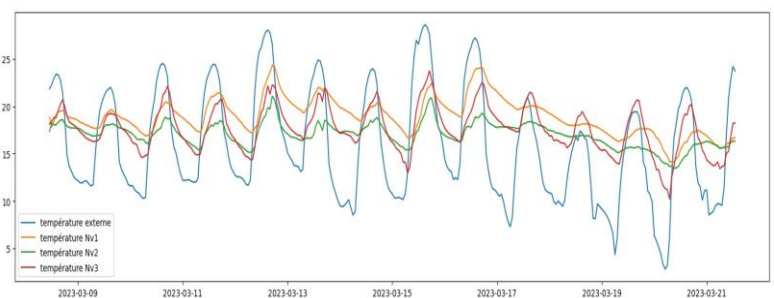
The prototype has enabled the establishment of a robust sensor network to monitor essential storage conditions that integrate:

- **Temperature sensors** to measure internal and external conditions of the silo.
- **Humidity sensors** to regulate humidity levels.
- **Real-time data collected** are transmitted to a cloud-based platform

A **mobile application** is used for notification to farmers regarding the critical storage conditions.

The findings highlight the **critical role of active ventilation, real-time environmental monitoring, and remote accessibility** in preserving onion quality and minimizing post-harvest losses. By optimizing airflow based on **sensor feedback and AI-driven automation**, the system prevents excess moisture buildup and temperature fluctuations—two key factors contributing to spoilage.

This research underscores the **economic and environmental benefits** of intelligent storage solutions, providing farmers and agribusinesses with a **sustainable, cost-effective approach** to extending the shelf life of onions and reducing food waste. Future improvements could explore **AI-driven predictive maintenance, renewable energy integration, and advanced user-friendly mobile interface enhancements** to make the system even more accessible for small-scale farmers.



Evolution of the temperature inside the Silo at the three depths (March 2023)