Master's Thesis project

(Fill in only the parts in light yellow)

This document has to be registered at the Students' Secretariat, not later than six weeks in advance of the Master's Thesis examination date

Title	Digital platform for the intelligent and sustainable distribution of fresh products through IoT and modular cloud-based architecture
Student	Nuria Álvarez Río
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Master's Thesis Tutor (he/she must be professor of the master program)	Ana Belén García Hernando and Miguel Ángel Valero Duboy
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Master's Thesis Director (fill only if there exists a director who is not a professor of the Master program. In this case, also the tutor's data have to be included above)	
Director's Department/Company	
Director's email	
Timeline (Estimated start and end dates)	1/5/2025 – 15/7/2025
Location(s) (Where the work will be carried out)	UPM, Madrid
Budget in € (If applicable)	

Description

Include a summary of the following aspects of the Master's Thesis you plan to carry out: **Objectives, description, methodology, tasks, materials to be used, time-schedule and bibliography**. Recommended length: 2 pages.

Objectives

The objective of this Master's Thesis is to develop an intelligent digital platform for the efficient, sustainable, and traceable distribution of fresh products, directly connecting producers, small retailers, supermarkets, and consumers. The system will be based on a scalable modular architecture that integrates IoT, Cloud Computing, and Blockchain technologies to optimize logistics, ensure transparency, and promote local purchasing.

The specific objectives include:

- Connecting key stakeholders in the food ecosystem (producers, retailers, consumers) through a unified platform.
- Optimizing the purchasing process through search and comparison algorithms based on price, distance, consolidation, or sustainability.
- Ensuring complete product traceability using blockchain technology.
- Integrating IoT sensors for monitoring environmental conditions (temperature, humidity) and real-time consumers location tracking.

Description
The project will be implemented as a mobile application connected to a cloud-based backend. The platform will allow users to search for fresh products in real time, apply personalized filters, and visualize an optimal combination of nearby sellers to complete their purchase. Each product will include environmental impact information, traceability data, and storage or transportation conditions when applicable.

Various IoT sensors will be integrated:
- Mobile sensors (user GPS): To calculate real distances and optimize pickup or delivery logistics.
- Environmental sensors (in farms or during transport): To record conditions such as temperature and humidity, ensuring optimal preservation and reducing food waste.

These data will be visualized in real time or stored on the blockchain for traceability and auditing purposes.

Methodology
The project follows an agile development methodology and is based on a three-layer architecture:

Cloud Backend (FastAPI + PostgreSQL):
- Modular and scalable RESTful endpoints.
- A database optimized to manage users, products, shopping lists, transactions and traceability.

IoT Computing Layer:
- Devices and sensors to record temperature, humidity, and location.
- Automated data collection from mobile apps and/or physical devices.

Traceability and Sustainability Layer:
- Blockchain for immutable recording of product history.

Tasks
1. Technical design of the architecture, database, and user flows.
2. Backend implementation and database integration.
3. Development of intelligent product comparison logic.
4. Integration of sensors and environmental data collection.
5. Implementation of traceability via blockchain.
6. Testing, documentation, and validation of the complete system.

Materials to Be Used
- FastAPI, SQLAlchemy, PostgreSQL, Pydantic.
- Mobile app (Android Studio – Java), GPS and sensor integration.
- Sensors: DHT11/DHT22 (temperature/humidity), GPS modules.
- Cloud infrastructure (e.g., Microsoft Azure).
- Blockchain libraries (e.g., Ethereum).

Estimated Timeline
Start: May 1, 2025
End: July 15, 2025

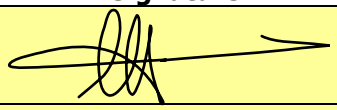
Timeschedule

Dates	Main Tasks
May 1-4	Define the platform architecture, user flows, and initial database structure.
May 5-11	Implement database models and basic endpoints using FastAPI and PostgreSQL.
May 12-18	Ensure full connection between endpoints and database, including user and product logic.
May 19-25	Develop the algorithm to compare products by price, distance, and sustainability.
May 26- June 1	Integrate GPS and environmental sensors (temperature/humidity) into the platform.
June 2-14	Record relevant events (products, transactions, sensor data) on blockchain.
June 15-22	Conduct end-to-end testing across backend, sensors, logic, and data flows.
June 23-29	Draft technical and functional documentation of the entire system.
June 30-July 6	Final system testing, performance evaluation, and memory revision.
July 7-17	Prepare slides, demos, and deliverables for the thesis presentation.

Bibliography

- Kleppmann, M. (2017). Designing Data-Intensive Applications. O'Reilly.
- Official documentation: FastAPI, Azure, PostgreSQL, IoT sensors, Blockchain.
- Academic publications on IoT applied to food traceability.
- FAO and European standards on environmental impact and food sustainability.
- Ries, E. (2011). The Lean Startup. Crown Currency.

Dates and signatures

	Date	Signature
Student		
Master's Thesis Tutor		Firmado por ANA BELEN GARCIA el día 02/06/2025 con
Master's Thesis Director		Firmado por VALERO DUBOY MIGUEL ANGEL - DNI ***7520** el día 03/06/2025 con un certificado emitido por AC Sector Público

Approval from the Master's Academic Coordination Commission

	Date	Signature
President of the Master's Academic Coordination Commission		