

MORE PRODUCTIVE CROPS WITH LESS EFFORT: THE REVOLUTION IN SMART PRECISION FARMING



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RESUMEN

Researchers at the University of Alicante have developed a modular hybrid cultivation system (hydroponic-substrate) with a multi-layer, multi-zone structure, featuring a distributed IoT digital architecture and integrated artificial intelligence. The system enables the precise monitoring and control of each plant's root microenvironment, autonomously optimising irrigation, nutrition and environmental conditions. Its main advantages over current solutions are the physical segmentation of the substrate into three distinct functional layers, the collaborative network between pots without a central node, and data-driven intelligent management. This innovative technology is beneficial for precision agriculture, indoor horticulture, greenhouses, vertical farming, nurseries and agronomic R&D&I projects.

We are seeking companies interested in acquiring this technology for commercial exploitation.

VENTAJAS Y ASPECTOS INNOVADORES

ADVANTAGES OF THE TECHNOLOGY

This technology offers the following **advantages**:

- 1) **Greater precision in crop management**: the division into three functional layers allows each zone to be monitored and managed independently, optimising the use of water, nutrients and environmental conditions with unprecedented precision.
- 2) **Significant reduction in water consumption**: calibrated drainage and autonomous irrigation control prevent waterlogging and wastage, **reducing water consumption by up to 40%** compared to conventional systems.
- 3) **Sensor insertion without removing the pot**: pre-formed holes allow probes to be inserted from the outside without interrupting the crop or damaging the roots, facilitating maintenance and calibration.
- 4) **Elimination of single points of failure**: the distributed mesh network eliminates dependence on a central node, ensuring system continuity in the event of individual failures.
- 5) **Full traceability by plant and phenological stage**: the platform records parameters and decisions in real time, generating auditable data for regulatory compliance and quality certifications.
- 6) **Reduced operating costs**: intelligent automation reduces the need for labour for monitoring and manual adjustments.
- 7) **Scalability and adaptability**: the modular design allows for a transition from pot-based to multi-batch channel formats without altering the technological architecture, adapting to different production scales.
- 8) **Lower environmental impact**: reduced water and fertiliser consumption, combined with a lower risk of contamination from leachates, contributes to more sustainable and environmentally friendly production.

INNOVATIVE ASPECTS OF THE TECHNOLOGY

The main innovation of this technology lies in the synergistic combination of three elements which, until now, had not been integrated into a single system:

1. A **multi-layer physical design** with external access to the sensors without the need to dismantle the plant pot.
2. A **distributed mesh IoT network** between plant pots with no central node.
3. A layer of **local artificial intelligence** with traceability by plant and phenological stage.

Unlike existing solutions that offer an optimised physical design without advanced connectivity or integrate basic IoT without functional compartmentalisation of the substrate, this invention simultaneously addresses all the technical causes of instability in the root microenvironment. The result is a **system that monitors all parameters in real time, learns, predicts and acts autonomously**, generating added value for the farmer.

From an industrial property perspective, no patent known to date combines externally accessible multi-layer compartmentalisation, networked cooperation without a central node between multiple growing units, and local artificial intelligence integrated into the pot's hardware, which gives this invention a **solid and differentiated competitive position** in the **smart growing systems market**.

APLICACIONES DE LA OFERTA

This innovative technology is particularly beneficial for the following **industrial sectors**:

- **Precision agriculture**: greenhouses, vertical farming and indoor farming with multi-zone control of irrigation, nutrients, data and artificial intelligence.
- **Forest and ornamental nurseries**: it promotes uniform rooting, traceability per plant and a reduction in losses.
- **Floriculture and ornamental production**: improved quality control, uniform flowering, precise irrigation, and batch and plant-level recording.
- **Food horticulture** (leafy vegetables, herbs, microgreens): stabilises electrical conductivity and pH, and reduces health risks.
- **Medical cannabis production** (GACP/GMP): ensures traceability by phase, as well as environmental and nutritional control. Serves as support for regulatory validation.
- **Medicinal plants, nutraceuticals and cosmetics**: standardisation of metabolites, reproducible batches and auditable records.
- **R&D&I and trials** (universities, technology centres, nurseries): phenotyping, comparative trials and digital twins.
- **Urban landscaping and smart cities** (green roofs, vertical gardens): remote maintenance, water savings and reporting.
- **Water management and treatment**: enables optimised dissolution and selective purging. Reduces biofilm formation and the accumulation of mineral salts.
- **Agricultural insurance and traceability**: objective data is collected by plant and phenological stage for the purposes of expert assessments and regulatory compliance.

COLABORACIÓN BUSCADA

Companies interested in acquiring this technology for commercial exploitation through patent **licensing agreements** are sought.

Company profile sought:

- Manufacturers of technical horticulture products.
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