



Project Bank Electricity and Industrial Automation Center

Projects related to precision agriculture

Centro de Electricidad y Automatización Industrial – CEAI

Innovation and Competitiveness Area

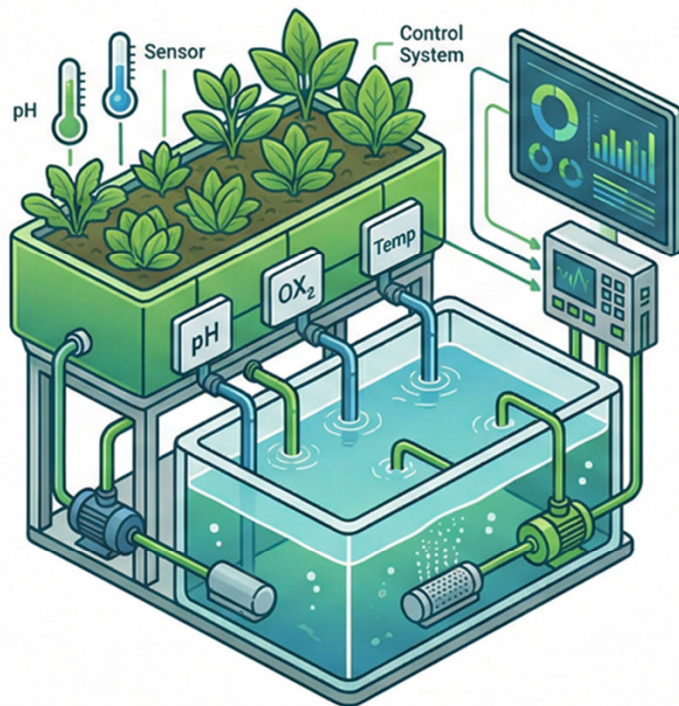
14-04-2026



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Enhancing aquaponic productivity through intelligent automation

Line: Intelligent Automation and Instrumentation for Process Optimization



Value Proposition

- Increased productivity in aquaponic systems
- Improved biological stability
- Reduced manual intervention

Technological Solution

- Real-time monitoring (pH, oxygen, temperature)
- Automated control of pumps and aerators
- Embedded control system
- Remote monitoring interface

Key Components

- Sensor network
- Microcontroller
- Actuators
- Monitoring dashboard

Impact

- Aquaculture producers
- Smart farming systems
- Training environments

Innovation and Competitiveness Area



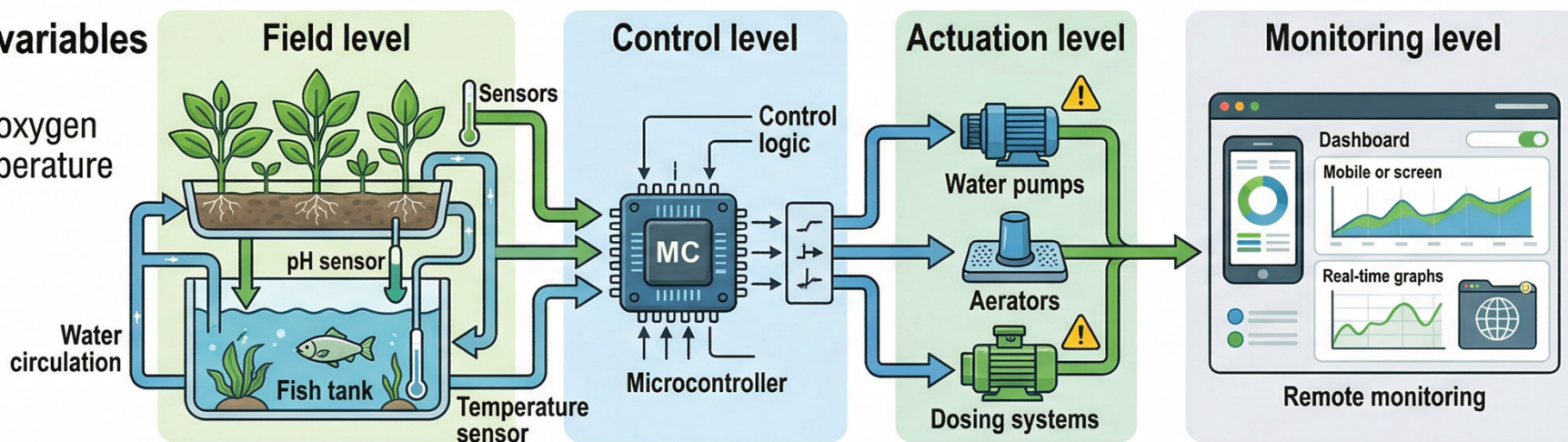
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Aquaponics automation system architecture

Integration of sensors, automated control, and real-time monitoring

Controlled variables

- pH levels
- Dissolved oxygen
- Water temperature



Controlled variables

- pH levels
- Dissolved oxygen
- Water temperature

Core functions

- Real-time monitoring
- Automated corrective actions
- Control of water quality parameters
- Data logging and remote supervision

Technical benefits

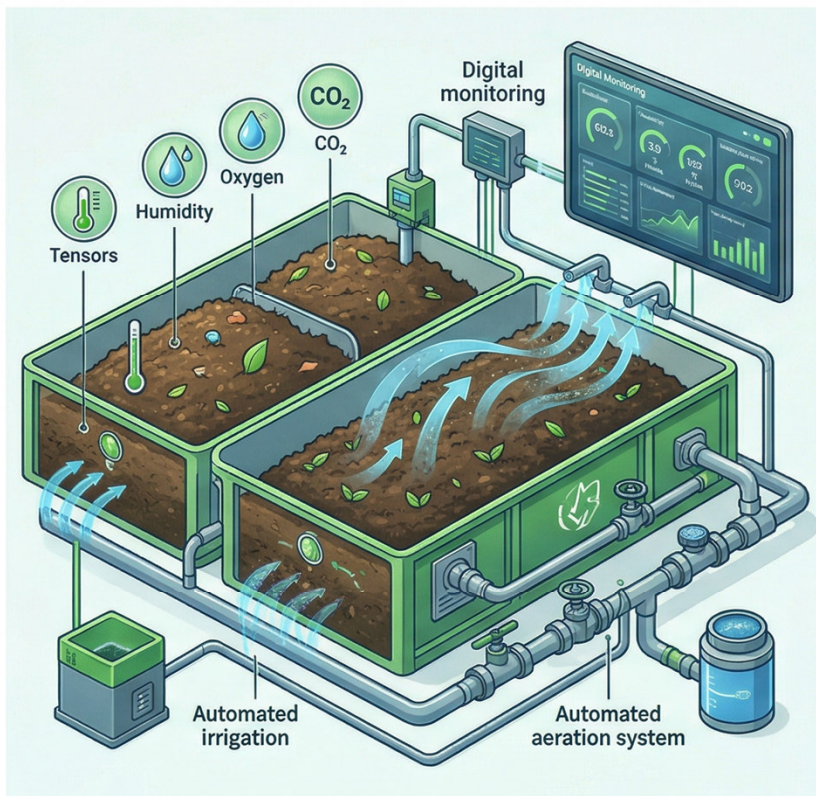
- Increased system stability
- Improved production efficiency
- Reduced manual intervention
- Scalable architecture

Innovation and Competitiveness Area



Optimizing composting through intelligent automation

Line: Intelligent Automation and Instrumentation for Process Optimization



■ Value Proposition

- Reduced compost maturation time
- Improved biological process efficiency
- Better compliance with sanitary requirements

■ Technological Solution

- Real-time monitoring (temperature, humidity, O₂, CO₂)
- Automated aeration and irrigation control
- PLC + HMI based architecture
- Data logging and process traceability

■ Key Components

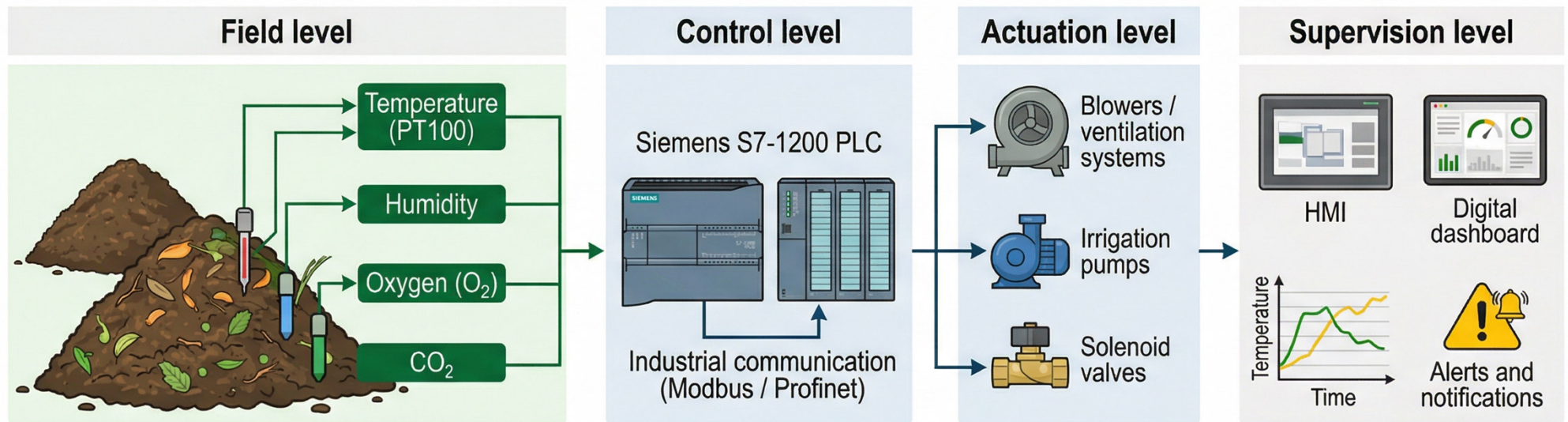
- Industrial sensors (PT100, humidity, gas sensors)
- Siemens S7-1200 PLC
- Frequency drives and actuators
- HMI supervision interface

■ Impact

- Agro-industrial sector
- Organic waste management
- Circular economy initiatives
- SENA technical training environments

Composting automation system architecture

Integration of sensors, industrial control, and real-time monitoring



Variables controlled

- Temperature (55–65°C)
- Humidity (40–60%)
- Oxygen (>10%)

Core functions

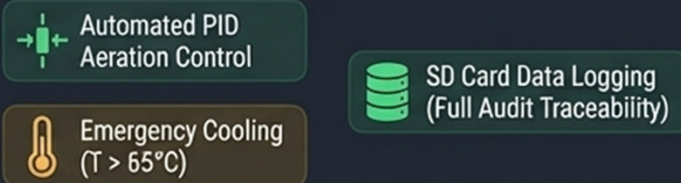
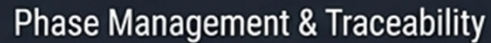
- PID temperature control
- Automated aeration
- Irrigation control logic
- Data logging and traceability

Technical benefits

- Scalable system architecture
- Safe operation in harsh environments
- Automation of biological processes

- ✔ Reduce Maturation
- ✔ Guarantee Food Safety
- ✔ End-to-End Automation

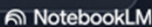
Architecture & Field Instrumentation



Investment Ticket

PLC & HMI:	\$2.1k - \$2.5k
Sensors & Inst.:	\$500 - \$900
Cabinet/Infra.:	\$300 - \$500
Drives & Actuators:	\$250 - \$350

12 Weeks



Inter-tree Communication Monitoring System

Biomimetics Applied Research Project

An integrated hardware and software platform for capturing, analyzing, and visualizing real-time biological signals between trees using edge intelligence and IoT.

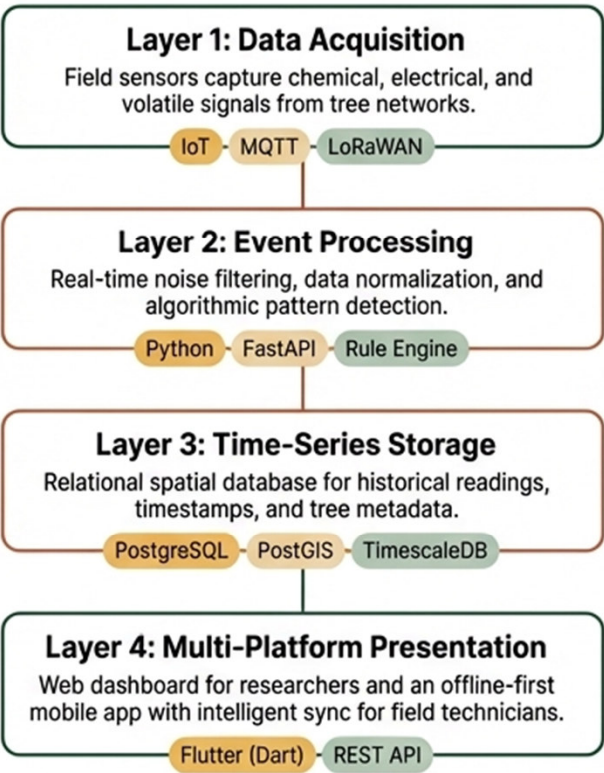
The Scientific Premise The Wood Wide Web



Forests are not collections of isolated individuals; they are cooperative, living communication networks. Through underground mycorrhizal networks, neighboring trees share vital nutrients and transmit chemical and electrical warning signals.

By decoding this biological communication, we shift forest management from observing individual trees to leveraging collective ecosystem intelligence.

The Engine 4-Layer Technical Architecture

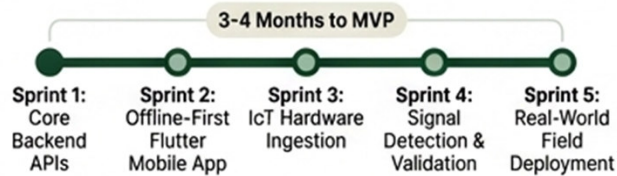


The Outcomes Strategic Impact & ROI

- Climate Resilience:** Connected forests sequester carbon more efficiently. Understanding network health optimizes mitigation strategies.
- Smart Reforestation:** Drives data-backed species selection based on active communication nodes and stress-resilient traits.
- Sustainable Agriculture:** Biomimetic application of these principles reduces chemical fertilizer dependency and improves modern soil health.

Partnership & Roadmap

\$20,000 – \$40,000 USD **2 Full-Time Developers**
Capital Requirement Resource Allocation





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Enhancing automated fruit sorting through robotics and computer vision

Line: Intelligent Automation and Instrumentation for Process Optimization



Value Proposition

- Enables automated fruit selection and classification
- Bridges training environments with real industrial applications
- Enhances learning in robotics and AI systems

Technological Solution

- Computer vision-based fruit detection and classification
- Integration of robotic arm with embedded control systems
- Automated pick & place execution
- Controlled environment for system validation

Key Components

- Robotic arm with gripper
- Jetson Nano (AI processing)
- Arduino-based motor control
- Camera-based vision system

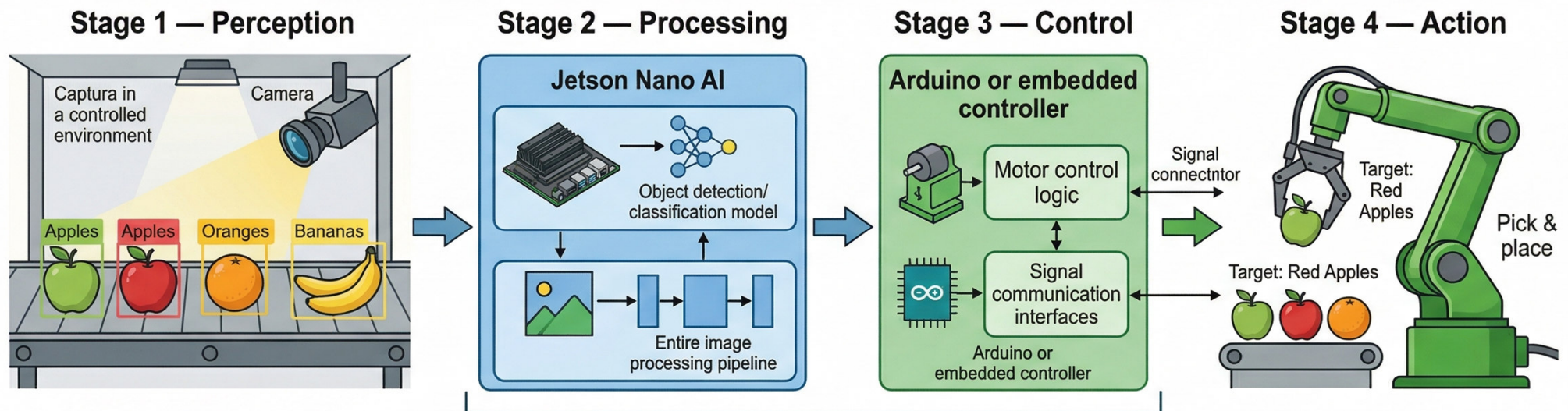
Impact

- Robotics and AI training environments
- Smart automation education (Industry 4.0)
- Applied learning in embedded systems
- Technology transfer to productive sectors

Innovation and Competitiveness Area

Robotic vision system architecture for automated fruit selection

Integration of computer vision, embedded AI, and robotic control systems



Key functions

- Real-time object detection
- Fruit classification
- Automated pick & place execution
- Closed-loop control between vision and actuation

System capabilities

- Configurable selection criteria (color, type, condition)
- Repeatable and controlled operation
- Integration of AI and robotics

Technical benefits

- Scalable architecture
- Hands-on training in Industry 4.0
- Simulation of real industrial automation processes



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Enhancing crop productivity through AI-based disease detection and harvest optimization

Line: Intelligent Automation and Instrumentation for Process Optimization



Value Proposition

- Early detection of crop diseases
- Improved decision-making for harvest timing
- Reduction of productivity losses

Technological Solution

- Computer vision-based disease detection
- CNN-based classification model (7 classes)
- Maturity stage identification
- AI-assisted agronomic recommendations

Key Components

- Image processing pipeline
- Deep learning model (CNN)
- Graphical user interface (GUI)
- Data logging and export module

Impact

- Agricultural producers (tomato sector)
- Precision agriculture systems
- Sustainable farming practices
- Technology transfer to rural environments



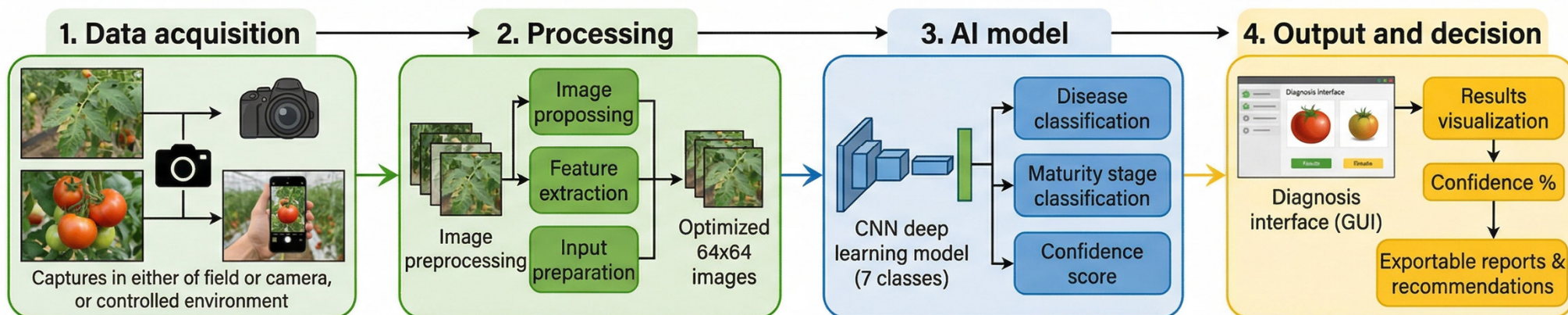
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AI-based system architecture for tomato disease detection and harvest optimization

Integration of computer vision, deep learning, and decision support systems

Core capabilities

- Early disease detection
- Multi-class classification
- Harvest timing support
- AI-assisted decision-making



Core capabilities

- Early disease detection
- Multi-class classification (7 classes)
- Harvest timing support
- AI-assisted decision-making

System components

- CNN deep learning model (.h5)
- Graphical user interface (GUI)
- Image processing module
- Data export module

Technical benefits

- Lightweight processing (optimized input size)
- Fast inference for real-time use
- Local execution (reduced cloud dependency)
- Scalable architecture

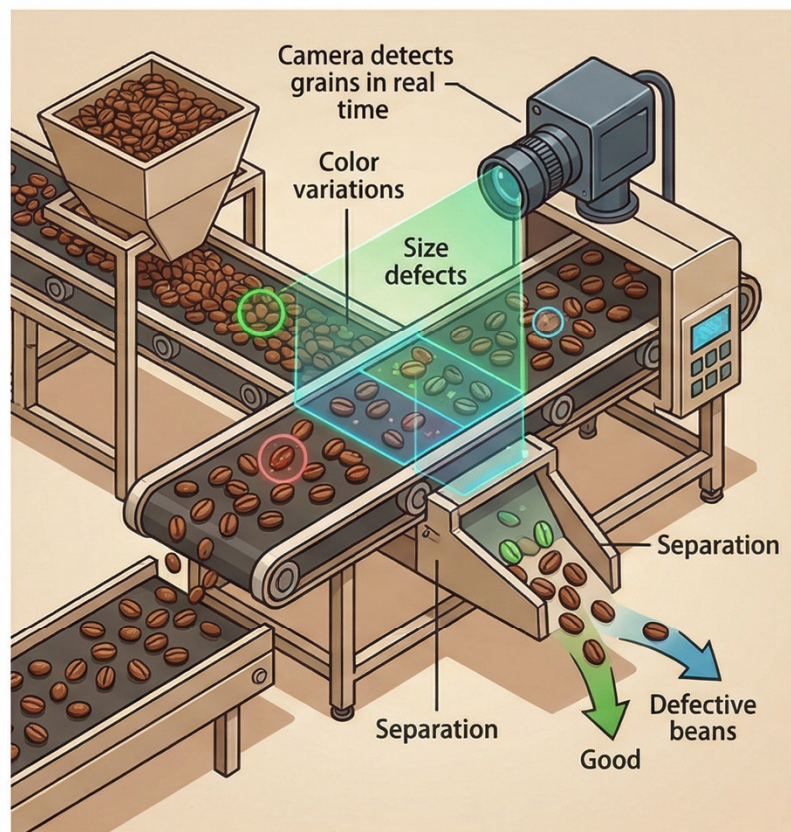
Innovation and Competitiveness Area



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Improving coffee quality and productivity through AI-based grain sorting

Line: Intelligent Automation and Instrumentation for Process Optimization



Value Proposition

- Improved coffee quality consistency
- Increased productivity in sorting processes
- Reduced manual labor and classification errors

Technological Solution

- Computer vision-based grain detection
- Machine learning classification (color, size, defects)
- Real-time sorting system
- Low-cost and replicable design approach

Key Components

- Vision system (camera + image processing)
- Machine learning model
- Conveyor and sorting mechanism
- Embedded control system

Impact

- Small and medium coffee producers
- Rural agricultural communities
- Coffee value chain modernization
- Adoption of Industry 4.0 technologies

Innovation and Competitiveness Area

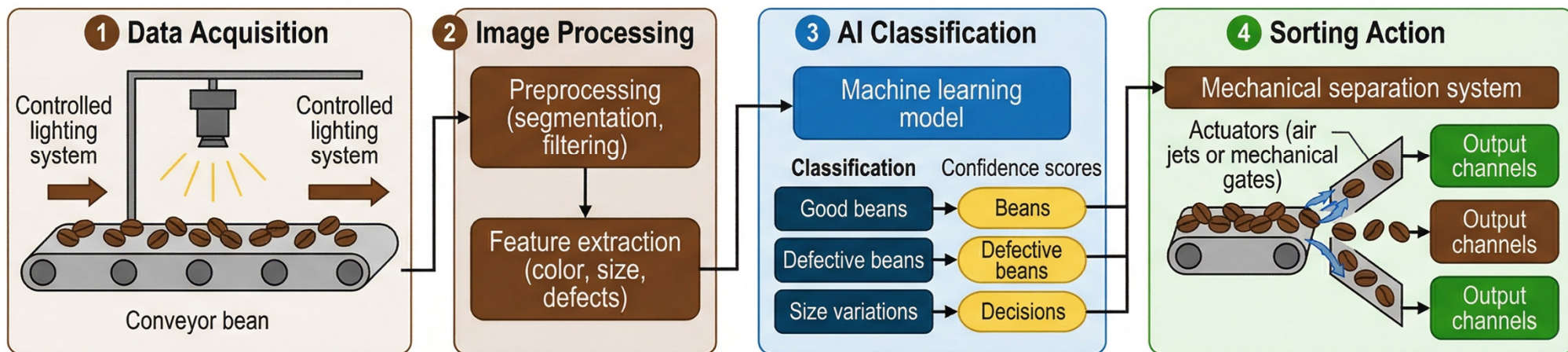


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AI-based system architecture for coffee grain classification

Integration of computer vision, machine learning, and automated sorting systems

Camera → Image processing → AI model → Sorting mechanism



Core Capabilities

- Real-time classification
- Multi-criteria sorting (color, size, defects)
- Automated separation process

System Components

- Vision system (camera + lighting)
- Machine learning model
- Conveyor system
- Sorting actuators

Technical Benefits

- Low-cost and replicable architecture
- Reduced dependency on manual labor
- Improved product quality consistency
- Adaptable to rural environments

Innovation and Competitiveness Area



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