Autonomous and Sustainable Agriculture Against the Climate Crisis: Agro Next Greenhouse

İlker Kaymak

Muğla Sıtkı Koçman University, Faculty of Engineering, Department of Electrical and Electronics Engineering,

Abstract

The agricultural sector is facing significant challenges due to climate change, water scarcity, increasing labor costs, and the growing demand for sustainable food production. To address these challenges, Agro Next is developed as an intelligent greenhouse system that aims to automate the entire agricultural production process, from sowing and planting to harvesting, by integrating artificial intelligence, robotic automation, renewable energy, and sustainable resource management.

Agro Next is designed as a modular and scalable infrastructure that can be adapted to agricultural production areas of different sizes, particularly large-scale facilities of approximately 1,000 m² (one decare). The system aims to autonomously manage the entire production cycle, including seed planting, irrigation, crop growth monitoring, environmental condition control, plant maintenance, harvest maturity detection, and robotic harvesting. Through the integration of sensor technologies, computer vision, and artificial intelligence-based decision-making mechanisms, the system aims to continuously monitor and optimize agricultural operations. Furthermore, solar energy systems and water filtration and recycling technologies are incorporated to reduce energy and water consumption while improving agricultural productivity and environmental sustainability.

Within the scope of an undergraduate graduation thesis, a small-scale experimental prototype is being developed to test the fundamental technologies of Agro Next and evaluate their technical feasibility. The prototype features an octagonal greenhouse structure with an approximate diameter of 60 cm and integrates a Raspberry Pi-based control system, environmental sensors, camera-assisted computer vision technologies, a four-degree-of-freedom robotic arm, and energy and water management components. This prototype represents an experimental model for validating the fundamental operating principles of the proposed system rather than its intended full-scale production capacity.

In addition to its academic scope, Agro Next has significant entrepreneurial potential and has qualified for the **LİDEA Pre-Incubation Program**. This achievement supports the project's ambition to progress beyond academic research and evolve into a technology-driven venture with practical applications in real agricultural production environments.

In conclusion, Agro Next aims to establish an integrated smart agriculture solution capable of automating agricultural operations from sowing to harvesting, reducing dependence on manual labor, optimizing natural resource utilization, and supporting sustainable agricultural production.

Keywords: Smart Greenhouse, Agricultural Robotics, Autonomous Agriculture, Artificial Intelligence, Precision Agriculture, Sustainable Agriculture, Robotic Harvesting.

MİDUG Thematic Area: WP6 – Digital Climate Solutions and Disaster Resilience.