Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 04, Issue: 03 (MAY-JUNE, 2024)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Artificial Intelligence in Horticulture

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Artificial Intelligence is an interdisciplinary field of study aiming to replicate human intelligence in robots that resemble human cognition and behaviour patterns. This recent technology plays an essential role in research and development in the field of horticulture. The prospective horticultural revolution emerges with the introduction of digital agriculture, industrialization and mechanization of production processes, networking and data management. Learning from prior data and making rapid & efficient decisions are the fundamental building blocks of AI.

The immense capability of AI will enable to choose suitable crop types, adopt improved soil and nutrient management practices, manage pests and diseases, estimate crop production and forecast commodity prices. The digital transformation of the horticulture sector offers enormous potential to Agricultural Economy. The aim of this article is to explore digital revolution in Horticulture and to render profound learning on application of Artificial Intelligence in Horticultural practices.

India has the opportunity to grow a wide variety of horticulture crops due to its various soil, climate, and agro-ecological zones. Horticultural crops, which comprise fruits, vegetables, medicinal, aromatic, and decorative plants, are important components of a balanced diet, sources of medication and fragrance, as well as possessing a variety of aesthetic benefits for people. Fruits and vegetables contribute to 90% of all horticulture production in the nation. Our nation currently produces 10% of the fruits and 14% of the vegetables consumed worldwide. The development of intelligent systems has increased the potential to improve the cultivation and management elements of horticulture crops on the basis of advances in technology and information analysis methodologies

Automated Irrigation System

The Internet of Things (IoT) -based smart irrigation system is a device that can automate the irrigation process by monitoring the soil's moisture content and meteorological conditions. Irrigation is one of the most labor-intensive processes in farming which can be avoided by artificial intelligence because it is aware of historical weather patterns, soil quality, and the type of crops to be grown.

Drone Technology

Through in-depth field analysis, long-distance crop spraying and high-efficiency crop monitoring, this technology is furnishing new ways to increase agricultural yields and is quickly turning into an indispensable tool for farmers. When using drones instead of traditional technology, the outcome of aerial spraying is five times faster.

Fruit Maturity Identification

Identifying the stage of fruit ripeness requires taking pictures of various crops under white/UV-A light. Particularly in the case of extremely perishable horticultural products,

farmers might develop multiple maturity grades based on the crop/fruit category and place them into separate stacks before delivering them to the market. Harvesting at the right maturity would also increase post-harvest shelf life. Apple-picking robots with artificial vision have achieved over 75% success rates.

Robotics Equipped Green Housing

Variety of robotics-based solutions can be created to simplify the growing and transportation of potted plants in Green Houses. In the meantime, AI has affirmed that combination of high amount of light, temperature, and CO_2 at the right moments during the production process are essential to obtain high profits in an autumn cucumber crop cycle. Further development will be needed to make AI a full alternative for the top grower-skills that are nowadays required for optimal greenhouse production

Fruit Harvesting Robot

These robots require picking up fruits without damaging the branches or leaves of the tree. The robots must be capable to access all areas of the tree being harvested and distinguish between fruits and leaves by using video image capturing. The camera is mounted on the robot arm and the colors detected are compared with properties stored in the memory. If a match is obtained, the fruit is harvested. If the fruit is hidden by leaves, an air jet can be used to blow leaves out the way for a clearer view. The pressure applied to the fruit is sufficient for removal from the tree, but not enough to bash the fruit. The shape of the gripper relies on the fruit being picked.

Disease Identification

Data from sensors, drones and satellites can be collected to help with crop cultivation. The information gathered can then be examined using AI in farming, allowing farmers to make more informed decisions. AI can be used in phenotyping to analyze a plant's biomass and characteristics. By analyzing changes in plant biomass and external factors to identify similar patterns between diseased crops, AI technology can be improved to detect the specific causes of these diseases. AI models enable real-time detection of crop diseases and nutrient deficiencies from aerial images for prompt intervention.

Autonomous Robot in Weed Control

A robot for lettuce weeding and thinning is used to boost lettuce productivity. Each plant is carefully inspected by its vision system, which then applies cutting-edge artificial intelligence algorithms that decide which plants to keep and which to get rid of in order to maximize productivity.

Automated Tractors

Automated tractors by combining ever-more complex software with “off-the-shelf” technologies like sensors, radars, and GPS systems will be bring enormous revolution in Horticulture sector.

Pioneering AI Opportunities

- **Agronomic Decisions:** Implementation of AI in farming decisions such as soil management, pest and weed management, disease management, crop management and water-use optimization.
- **Yield Prediction:** Cost-benefit assessment to improve profits based on local/tacit farming knowledge and recommendation actualized through digital platforms. Predictions and recommendations driven by AI models can help farmers reduce fertilizer overuse, forecast uncertainties such as plant and livestock-based diseases, and monitor soil conditions to prevent yield loss.

- **Social and Environmental Impact:** AI-based agriculture can benefit from availability and development of skilled workforce in the domains of computer science, agronomy and plant science, animal science, and social sciences. Sustainability of food and water systems, food-security for global population and resource optimization.

Recent Innovations

The recent revolutionary innovations regarding Artificial Intelligence in Horticulture include:

- Trace Genomics
- Farm Shots
- aWhere
- Crop sensors
- Plant phenotyping of horticultural crops
- AI for Crop Morphology Measurements and Crop physiology performance
- Harvest CROO Robotics strawberry harvester and "See & Spray" Robot have been invented for Weed Control and Crop Management. Plantix Software algorithms analyze data and tie certain foliage patterns to specific soil issues, plant pests, and plant illnesses and also detect probable flaws and nutrient deficits in soil.

Conclusion

Incorporating this fine Artificial intelligence technology in the field of Horticulture enhances the massive growth of Agricultural Economy globally. Extensive use of precise AI technology for advanced Horticultural practices offers numerous opportunities to farmers to increase crop yield with excellent quality.

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