e-ISSN: 3048-8796

ROBOTIC AGRICULTURE

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INTRODUCTION

Artificial Intelligence (AI) is one of the key areas of research in computer science. With rapid technological advancement and vast area of application, AI is becoming pervasive. It's robust applicability in the problems particularly that cannot be solved well by humans as well as traditional computing structures AI have been found to be the most excellent performers for the accuracy and robustness. These techniques have enabled us to capture the intricate details of each situation and provide a solution that is best fit for that particular problem. Gradually very complex problems are being solved with the development of various AI techniques.

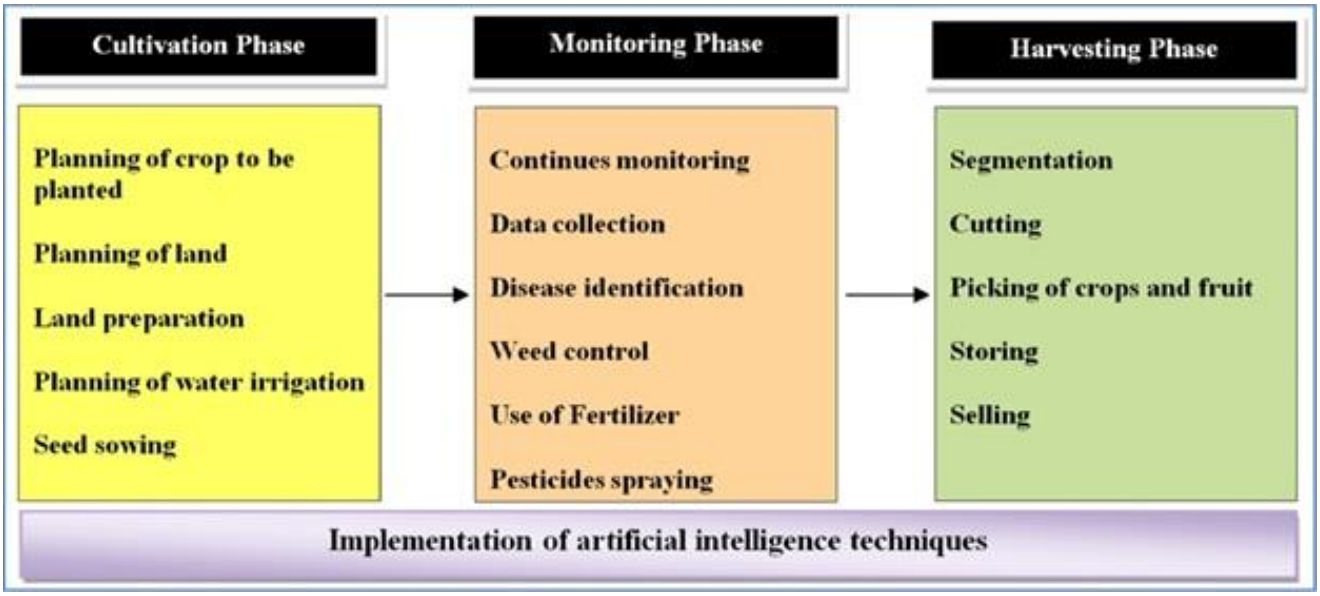
AI and Agriculture

Agriculture has a significant contribution to the economy. The world's population is quickly growing, resulting in increased demand for food and labor. At present, most agricultural activities are traditionally practiced, resulting in non-profitable and non-economic farming. Farmers' customary techniques are insufficient to achieve these goals.

- Lack of accurate information on weather, soil conditions, and use of fertilizers.
- It takes more time and effort to monitor crops' health and disease identification manually.
- It requires more labor for weed identification and control.
- Traditional spraying of pesticides affects the health of the farmers as well as reduces crop productivity.
- Old ways of crop cutting and segmentation of healthy crops and fruits are tedious tasks.
- Poor practices in storing harvested food led to its degradation.

Use of AI in agriculture

Traditional farming involves various manual processes. Implementing AI models can have many advantages in this respect. By complementing already adopted technologies, an intelligent agriculture system can facilitate many tasks. AI can collect and process big data, while determining and initiating the best course of action. Here are some common use cases for AI in agriculture:



Traditional farming without AI and robotics sufferers from-

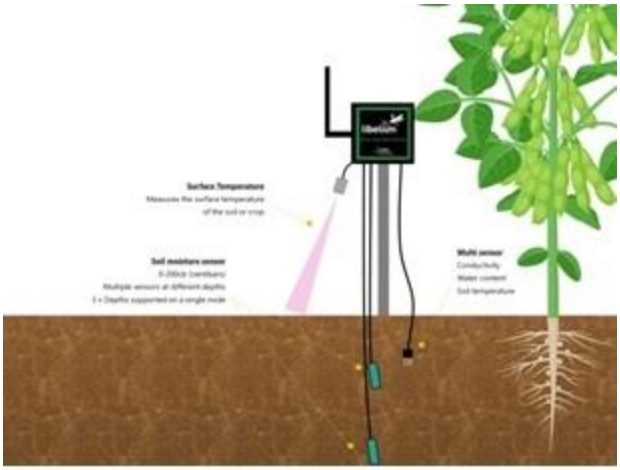
- It is more time-consuming and requires much effort to prepare and plan land, irrigation, and seed sowing.
- Involves more human resources for handling the various agriculture processes.

Irrigation management

AI algorithms enable autonomous crop management. When combined with IoT (Internet of Things) sensors that monitor soil moisture levels and weather conditions, algorithms can decide in real-time how much water should be provide to crops. An autonomous crop irrigation system is designed to conserve water while promoting sustainable agriculture and farming

practices. AI in smart greenhouses optimizes plant growth by automatically adjusting temperature, humidity, and light levels based on real-time data.

AI incorporates weather data alongside crop water requirements to identify areas with excessive water usage. AI plays a crucial role in detecting leaks in irrigation systems and provide alerts. By analyzing data, algorithms can identify patterns and anomalies that indicate potential leaks. Machine learning (ML) models can be trained to recognize specific signatures of leaks, such as changes in water flow or pressure. AI technology enhances water efficiency helping farmers conserve resources.



Detecting disease and pests

Computer vision can detect the presence of pests or diseases. This works by using AI in agriculture projects to scan images to find mold, rot, insects, or other threats to crop health. In conjunction with alert systems, this helps farmers to act quickly in order to exterminate pests or isolate crops to prevent the spread of disease. It can also identify insects like flies, bees, moths, etc., with the same degree of accuracy.

Crop and soil monitoring

The wrong combination of nutrients in soil can seriously affect the health and growth of crops. Identifying these nutrients and determining their effects on crop yield with AI allows farmers to easily make the necessary adjustments. While human observation is limited in its accuracy, computer vision models can monitor soil conditions to gather accurate data necessary for combatting crop diseases. This plant science data is then used to determine crop health, predict yields while flagging any particular issues. Plants start AI systems through sensors that detect their growth conditions, triggering automated adjustments to the environment.

Monitoring livestock health

It may seem easier to detect health problems in livestock than in crops, in fact, it's particularly challenging. Thankfully, AI for farming can help with this. A technique for monitoring the health of farm animals / dairy cattle with a high degree of accuracy uses a camera and artificial intelligence (AI) to achieve a "smart" cow house. Detailed observation by AI-powered image analysis enable early detection of injuries and illnesses that could impact the quantity and qualityof milk production. AI and ML are solutions that determine the impact of diet alongside environmental conditions on livestock and provide valuable insights. This knowledge can help farmers improve the well-being of cattle to increase milk production.

Automatic weeding and harvesting

AI can also be used to detect weeds and invasive plant species. When combined with machine learning, computer vision analyzes the size, shape, and color of leaves to distinguish weeds from crops. Such solutions can be used to program robots that carry out robotic process automation (RPA) tasks, such as automatic weeding. As these technologies become more accessible, both weeding and harvesting crops could be carried out entirely by smart bots.

Intelligent pesticide application

Farmers are well aware that the application of pesticides is ripe for optimization. Unfortunately, both manual and automated application processes have notable limitations. Applying pesticides manually offers increased

precision in targeting specific areas, though it might be slow and difficult work. Automated pesticide spraying is quicker and less labor-intensive, but often lacks accuracy leading to environment contamination. AI-powered drones provide the best advantages of each approach while avoiding their drawbacks. Drones use computer vision to determine the amount of pesticide to be sprayed on each area.

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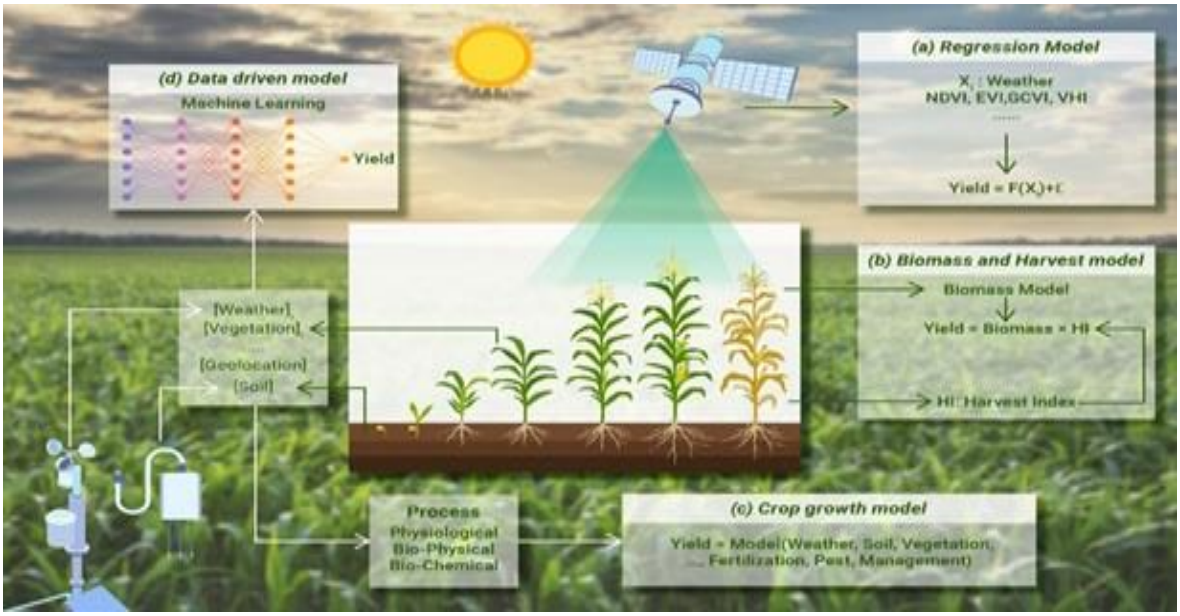

Yield mapping and predictive analytics

Yield mapping uses ML algorithms to analyze large datasets in real time. This helps farmers understand the patterns and characteristics of their crops, allowing for better planning. By combining techniques like 3D mapping, data from sensors and drones, farmers can predict soil yields for specific crops. Data is collected on multiple drone flights, enabling increasingly precise analysis with the use of algorithms.

These methods permit the accurate prediction of future yields for specific crops, helping farmers know where and when to sow seeds as well as how to allocate resources for the best return on investment.

Sorting harvested produce

AI is not only useful for identifying potential issues with crops while they're growing. It also has a role to play after produce has been harvested. Most sorting processes are traditionally carried out manually, AI can sort produce more accurately.

Computer vision can detect pests as well as disease in harvested crops. It can grade produce based on its shape, size, and color. This enables farmers to quickly separate produce into categories — for example, to sell to different customers at different prices. In comparison, traditional manual sorting methods is labor-intensive.

Surveillance

Security is an important part of farm management. Farms are common targets for burglars, as it's hard for farmers to monitor their fields around the clock. Animals are another threat — whether it's foxes breaking into the chicken coop or a farmer's own livestock damaging crops or equipment. When combined with video surveillance systems, computer vision and ML can quickly identify security breaches.

CONCLUSION

AI-driven technologies are emerging to help improve efficiency and to address challenges facing the industry including, crop yield, soil health and herbicide-resistance. AI-enabled technologies use data like temperature, precipitation, wind speed, and solar radiation in combination with ML algorithms and images taken by satellites and drones to predict weather conditions, analyse crop sustainability, and evaluate farms for the presence of diseases or pests and inadequate plant nutrition. AI aids in the detection of soil issues such as clogs and leaks. It assesses and rates the soil's poor condition; AI assists in increasing farm productivity. The net output from the field is improved by automated and autonomous farming operations, AI-enabled productions, and yield management. Farmers' problems, such as climate change and insect and weed infestations that lower yields, may be resolved through AI solutions. AI will be used in agriculture to improve the entire agriculture process and agricultural robots are poised to become a highly valued application of AI in this sector.

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