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Artificial Intelligence in Agriculture

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Abstract
Recently, the agriculture industry has seen the application of artificial intelligence (AI). To increase production, the industry must overcome a number of obstacles, including poor soil management, insect and disease infestation, the need for large amounts of data, low output, and a knowledge gap between farmers and technology. The major ideas behind AI in agriculture are its adaptability, excellence, accuracy, and economy. This essay provides an overview of the ways artificial intelligence has been applied to managing weeds, diseases, crops, and soil. The application's strengths and weaknesses are highlighted, as well as how to use expert systems to increase productivity.

Keywords: Artificial intelligence; Agriculture; soil management; crop management; disease management; weed management.

Introduction
Any economy's ability to remain sustainable rests on agriculture. It is essential for long-term economic growth and structural change, however it varies across nations. Agriculture used to be solely concerned with growing crops and food. However, it has changed during the past 20 years to include the processing, production, marketing, and distribution of crops and livestock products. Currently, agricultural operations provide the primary means of subsistence while increasing GDP, contributing to national commerce, lowering unemployment, supplying raw materials for other industries to produce goods, and generally developing the economy. It is essential that agricultural methods be evaluated in order to offer novel solutions for sustaining and enhancing agricultural activities given the exponential rise in world population. Other technological advancements, such as big data analytics, robotics, the internet of things, the accessibility of inexpensive sensors and cameras, drone technology, and even widespread internet connectivity on geographically separated fields, will make it possible to apply AI to agriculture.

Consideration
There are many options and unknowns in farming. Weather fluctuates, agricultural input costs alter, soil deteriorates, crops fail, weeds choke out crops, pests wreak havoc on crops, and the climate shifts from season to season. Farmers must manage these unknowns. Although the field of agriculture encompasses a wide range of activities, this study emphasizes the importance of soil, crops, disease, and weeds in agricultural productivity. Reviewing the use of AI in agriculture with regard to soil, crop, disease, and pest control is crucial.

- The soil is the primary source of the nutrients utilised to grow crops, making it an essential component of successful agriculture. All agricultural, forestry, and fishing

production systems are based on soil. In order to make water, minerals, and proteins available for healthy crop growth and development, soil stores these items.
- The cultivation of crops is very important to India's economy. Food, raw resources, and jobs are all provided. Marketing, processing, distribution, and after-sales service are now recognised as essential components of crop production. Crop cultivation and other core industries are being prioritised in regions with low real income per capital. It has been seen that increasing crop productivity and output have a significant positive impact on a nation's overall economic development.
- One of the biggest dangers to all agricultural activity is weeds. Weeds damage cattle occasionally, decrease farm and forest output, infiltrate pastures, and suffocate crops. They fiercely contend with the crops for sunlight, nutrients, and water, which slows down crop growth.

Soil Management

A crucial component of agricultural activity is soil management. Crop production will be improved and soil resources will be conserved with thorough knowledge of different soil types and conditions. It is the application of procedures, methods, and treatments to enhance the functionality of soil. A conventional soil survey approach can be used to examine if urban soils contain contaminants. Compost and manure applications increase soil aggregation and porosity. Better aggregation shows the presence of organic components, which are crucial in preventing the formation of soil crusts. To stop the physical deterioration of soil, alternate tillage techniques can be used. To enhance the quality of the soil, organic materials must be used. . Several soil-borne pathogens that need to be controlled through soil management frequently have a significant impact on the production of vegetables and other edible crops. Given that soils vary in their capacity to withstand change and recover, consideration of soil degradation is implicit in any assessment of the sustainability of land management practices. Three stages of engineering knowledge are required to build the Soil Risk Characterization Decision Support System (SRCDSS):knowledge acquisition, conceptual design and system implementation. An artificial neural network (ANN) model predicts soil texture (sand, clay and silt contents) based on attributes obtained from existing course resolution soil maps combined with hydrographic parameters derived from a digital elevation model.

Crop Management

Sowing is the first step in crop management, which also includes crop harvesting, crop storage, and crop distribution. It can be summed up as actions that increase the yield and growth of agricultural products. Crop yield will undoubtedly increase with a thorough understanding of the class of crops according to their timing and thriving soil types. In order to maximise profitability and safeguard the environment, precision crop management (PCM) is an agricultural management system that targets crop and soil inputs in accordance with field needs. Lack of timely, widely disseminated information on crop and soil conditions has hampered PCM. To deal with a water deficit brought on by the soil, the weather, or insufficient irrigation, farmers must combine a variety of crop management techniques. It is preferable to use flexible decision-based crop management systems. When deciding between cropping options, drought timing, intensity, and predictability are crucial factors. A thorough understanding of weather patterns aids in decision-making for high-yielding, high-quality crops. For assessing the operational behaviour of a farm system, PROLOG makes use of weather information, machinery capacities, labour availability, and data on authorised and prioritised operators, tractors, and implements. Additionally, it calculates crop production, gross income, and net profit for both the entire farm and each individual field. By sensing various soil parameters and parameters related to the atmosphere, crop prediction methodology is used to predict the appropriate crop. soil type, PH, nitrogen, phosphate, potassium, organic carbon, calcium, magnesium, sulphur, manganese, copper, and iron, as well as depth, temperature, rainfall, and humidity, are examples of such factors. The speed-rowing machine Demeter is computer-controlled, and it has two cameras, as well as a GPS for navigation. It has the capacity to plan out harvesting operations for an entire field, implement those plans by cutting crop rows, turning to cut subsequent rows, moving around the field, and spotting unforeseen obstacles. The individual hardware and software parts of the robot, such as the autonomous vehicle, the manipulator, the end-effector, the two computer vision systems for detection and 3D imaging of the fruit and environment, and, finally, a control scheme that generates collision-free motions for the manipulator during harvesting, make up the use of AI in cucumber harvesting. For each site, rainfall information and weather variables can be used.

Disease Management

Disease control is essential for agricultural harvests to produce their best yield. Diseases in plants and animals are a significant barrier to increased output. These diseases, which affect both plants and animals, are caused by a variety of factors, including genetics, soil type, rain, dry weather, wind, temperature, and others. Managing the impacts is a huge difficulty as a result of these elements and the unstable character of some diseases' causal influences, especially in large-scale farming. A farmer should adopt an integrated disease control and management approach that combines physical, chemical, and biological measures in order to successfully control illnesses and minimise losses. Since achieving them takes time and isn't particularly cost-effective, using AI to disease control and management is necessary. The explanation block (EB) provides a clear picture of the reasoning used by the expert system's core. The system for making intelligent inferences for agricultural disease management employs a novel approach of rule promotion based on fuzzy logic.

Weed Management

The predicted profit and yield for farmers are regularly decreased by weed. According to a survey, uncontrolled weed infestations will result in a 50% decrease in the output of dried bean and maize crops. Due to weed competition, wheat yield is reduced by roughly 48%. These losses could occasionally reach 60%. A research on the effects of weed on soybean output revealed an 8%–55% decline. According to a study on yield losses in sesame crops, they range from 50% to 75%. The length of the crops' exposure to the weeds and the spatial heterogeneity of the weeds may be responsible for the variation in yield losses. Beyond this, cannabis affects the ecosystem in both beneficial and harmful ways. Weed effects include flooding during hurricanes, some species of weeds can clear the way during wildfires, some cause irreversible liver damage if consumed, and they outcompete plants or crops by competing for water, nutrients, and sunlight, according to a relevant Weed Science Society of America (WSSA) report. Some weeds are toxic, allergic reaction-producing, or even potentially dangerous to public health. Unmanned aerial vehicle (UAV) imagery can be used by a system to partition images, compute and convert vegetation indexes to binary, recognise crop rows, optimise parameters, and learn classification models. Given that crops are typically arranged in rows, using a crop row recognition technique makes it easier to distinguish between crop and weed pixels, which is a common challenge given their similar spectral properties. In order to control weeds in winter wheat, winter barley, sugar beet, maize, and other crops, weeds can be detected online utilising digital picture analysis from a UAV (drone), computer-based decision-making, and GPS-controlled patch spraying.

Curtailing Challenges of AI in Agriculture

Expert systems are useful tools for managing agriculture because they can offer recommendations that are site-specific, integrated, and interpreted. Expert systems for agriculture have, however, only recently been developed, and they haven't been widely used in commercial agriculture yet. Although AI has achieved some notable advancements in the agricultural industry, when compared to its potential and impacts in other industries, it still has a below average impact on agricultural activities. Since AI deployment has numerous drawbacks, more work needs to be done to improve agricultural activities.

A. Limitation: Speed of response and accuracy The ability of an intelligent or expert system to complete tasks accurately in a short amount of time is one of its key characteristics. Most systems are either inaccurate or slow to respond, or even both. The task strategy that a user chooses is impacted by a system delay. The cost function that combines the effort needed to synchronise input system availability with the accuracy level offered is speculated to be the basis for strategy selection. Three methods are available to those who want to exert the least amount of effort while getting the best results: automated performance, pacing, and monitoring.
B. Limitation: Big Data Is Necessary The amount of input data is another factor in determining an intelligent agent's power. A real-time AI system must keep an eye on a huge amount of data. Most of the incoming data must be filtered away by the system. It must, however, continue to respond to significant or unexpected occurrences.
C. Limitation: Implementation Method Any expert system's execution strategy is what gives it beauty. The method of looking-up and training should be well described for speed and accuracy because it employs vast data.

Conclusion

The lack of efficient irrigation systems, weeds, difficulties with plant monitoring owing to crop height, and harsh weather conditions are only a few of the difficulties the agricultural sector encounters. But with the help of technology, performance may be improved and these issues can be resolved. It can be improved with a variety of AI-driven strategies, such as automatic watering using GPS and remote sensors to determine soil moisture content. Farmers had the issue that precision weeding techniques outweighed the substantial number of crops lost throughout the weeding procedure. These autonomous machines not only increase productivity but also lessen the demand for pointless pesticides and herbicides. In addition, drones enable farmers to spray pesticides and herbicides efficiently on their land, and plant monitoring is no longer a bother. With the use of man-made brain power, resource and employment shortages can first be comprehended in terms of agribusiness difficulties. For crop parameters including plant height, soil texture, and content, traditional methods needed a significant amount of effort, which resulted in repetitive manual testing. Quick and non-destructive high throughput phenotyping with the benefit of flexible and favourable activity, on-demand information access, and spatial goals would be possible with the aid of the various systems evaluated.

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