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Artificial Intelligence Application in Agriculture

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Introduction:

The term "Artificial Intelligence" was first introduced in the 1955 Dartmouth Conference, in which John McCarthy proposed a study to be carried out grounded on the hypothesis that "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it" [1]. Nowadays, AI, one of the essential areas in computer science, has penetrated a variety of domains, such as education, healthcare, finance and manufacturing, because of its nature to tackle problems that cannot be solved well by humans [2]. Humans continue to be shocked by AI's capacities. One example is IBM's Deep Blue's historical victory over world chess champion Garry Kasparov in 1997 and the triumph of AlphaGo over the world Go champion Lee Sedol in 2016, which proves that deep learning, the principle that AlphaGo is based on, enables AI to surpass the most human brainpower.

Current status of AI application in Agriculture –

Soil Management-

AI can be used to make soil maps, which helps to show soil-landscape relationships and various layers and proportions of soil underground

Weed Management-

Artificial intelligence weed detection systems have been tested in laboratories to calculate the precise amount of spray to be used and to spray on the target location accurately, which also lower costs and the risk of damaging crops.

The Use of Internet of Things Technology-

The Internet of Things (IoT) is a system consisted of computing devices, mechanical machines and various objects that are interrelated, and each is provided with a unique identifier and possesses the capability of data transfer. Therefore, human-to-human or human-to-computer interactions can be avoided. IoT is an advancement built on several existing technology, such as wireless sensor networks (WSNs), cloud computing and RF identification. IoT can be applied in manifold fields, such as monitoring, precision agriculture, tracking and tracing, greenhouse production and agricultural machinery.

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Artificial intelligence (AI)-based opportunities in agriculture-

Agronomic decisions- Implementation of AI in farming decisions such as soil management, pest and weed management, disease management, crop management and water-use optimization.

Economic performance- 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.

Supporting inclusive growth in developing economies- AI-based agricultural technologies can prevent market and information asymmetries in food value chains at the local and global level if data is shared transparently and responsibly.

Social mobility- 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.

Social and environmental impact- Sustainability of food and water systems, food-security for global population, and resource optimization.

How AI is used in Agriculture-

- Automated farming activities.
- Identification of pest and disease outbreak before occurrence.
- Managing crop quality.
- Monitoring biotic.
- Abiotic factors and stress.
- Machine vision systems and phenotype lead to adjustments.

Automated irrigation System:

Effect of Uses:

- Reducing production costs of vegetables, making the industry more competitive and sustainable.
- Maintaining average vegetable yields.
- Minizing environmental impacts caused by excess applied water and subsequent agrichemical leaching.
- Maintaining a desired soil water range in the root zone that is optimal for plant growth.
- Low labor input for irrigation process maintenance
- Substantial water saving compared to irrigation management based on average historical weather conditions.

AI-Remote sensing: Crop Health Monitoring:

- Hyperspectral imaging and 3D laser Scanning, are capable of rapidly providing enhanced information and plant metrics across thousands of acres with the spatial resolution to delineate

individual plots and plants and the temporal advantage of tracking change throughout the growing cycle.

- The trained use of hyperspectral imaging, spectroscopy and 3D mapping allows for the substantial increase in the number of scalable physical observables in the field.
- In effect, the multi sensor collection approach creates a virtual world of phenotype data in which all the crop observables become mathematical values.

AI for Harvesting vine crops:

Conventional methods are often time consuming and generally categorical in contrast to what can be analyzed through automated digital detection and analysis technologies categorized as remote sensing tools.

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Decision support system for field prediction using AI techniques-

- This system involves a set of Artificial intelligence based techniques.
- Artificial neural networks
- Genetic algorithms
- Grey system theory
- Use of artificial intelligence based methods can offer a promising approach to yield prediction and compared favorably with traditional methods.

AI-Driver less tractor-

Using even-more sophisticated software coupled with off the shelf technology including sensor, radar, and GPS, the system

allows an operator working a combine to set the course of a driverless tractor pulling a grain cart, position the cart to receive the grain from the combine, and the send the fully loaded cart to be unloaded.

AI for weeding-

The hortibot is about 3-foot-by-3-foot, is self-propelled and uses global positioning system. It can recognize 25 different kinds of weeds and eliminate them by using its weed-removing attachments

HortiBotis eco-friendly, because it sprays exactly above the weeds.

As the machine is light- between 200 and 300 kilogram, so it will not hurt the soil behind it.

It is also cheaper than the tools currently used for weed-elimination as it can work during extended periods of time.

Development of Agriculture Robots-

One field of applications that AI plays an important role in is the robotics system, and to incorporate robotics into agriculture and to improve the efficiency, reliability and precision have been attempted for years, which would dramatically replace manual labor needed with automatic labor- intensive work. Automation are keys to pressing social phenomena such as aging population and decreasing population, but to be able to accomplish the accurate and complicated operations that were traditionally done by farmers to maintain the good quality always remains as a great challenge.

Challenge of agricultural robots-

Although the study of agricultural robots has made tremendous progress, robots that are applicable to work in complex agricultural environment are still not available in the market. The main reason was that algorithms that can cope with the uncontrolled and unpredictable real agricultural environment have not been developed yet, and other factors, such as the seasonality of agriculture, also marks the difference between real environment and experimental environment in laboratories. The dynamic and rapid changing in time and space of

agricultural environment are almost unavoidable, no matter in unstructured environments, such as military and space environments, or in environment where atmospheric conditions have uncertainty inherently, like rugged terrain, visibility and illumination.

Benefits of Artificial intelligence-

- Intelligent system for classifiers for early diagnosis of plant pests, reducing the consumption of agricultural pesticides, saving costs, and reducing environmental pollution.
- A responsive web application with deep learning that exploited the collected data.
- Intelligent systems use big data applications to predict insights into the food supply chain.
- An intelligent system using the cloud was developed to accurately and rapidly process, analyze, and visualize data collected from UAVs.
- Robots and drones optimized the use of water and pesticides and increased productivity and quality.
- A low-cost system with remote monitoring was portable, lightweight, and user-friendly.

Challenges of AI in agriculture: first, due to certain geographical, social or political reasons, the distribution of modern technology is uneven, which foreshadows that the application of AI will have its limitation in certain areas; secondly, despite significant improvements made in the past years, to transfer AI-based machines and algorithms from control experiments to real agricultural environment requires much more studies and research, and to be able to handle large sets of data and to interpret them accurately and quickly are two main challenges that need to be addressed in order to enable the application; finally, the security of devices used in open spaces of agricultural environment and the privacy of data collected are also problems to address.

Conclusion-

Artificial intelligence holds tremendous potential to revolutionize agriculture by optimizing processes, increasing yields, and reducing resource usage. From precision farming to crop monitoring and disease detection, AI technologies offer innovative solutions to address challenges in the agricultural sector. However, widespread adoption requires addressing issues such as data privacy, accessibility, and the digital divide. With continued research, development, and collaboration, AI can contribute significantly to sustainable and efficient agricultural practices in the future.