Role of AI in Agriculture

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Introduction

In India, the agricultural sector has significant importance in the economy, since 58% of all families rely on it for their livelihoods, either directly or indirectly. The industry is facing several obstacles at every stage of the value chain at this pivotal moment. While the integration of digital technology can aid in mitigating some obstacles, its progress has been inconsistent and has not expanded sufficiently.

Among the challenges that the agriculture industry faces are the following:

- Unsustainable agricultural methods, leading to soil degradation and water stress
- Small and marginal farmers, comprising 86% of farmers, hold less than two hectares of land, resulting in unsustainable farm earnings and poverty
- Absence of datasets at the sector, farm, and farmer levels drives up service prices gaps in market connections, difficulties farmers face in determining prices, and market price volatility
- Lack of infrastructure for food processing, shipping, and warehousing near farm gates increases waste
- Obstacles to digital and financial inclusiveness
- Low agricultural mechanisation as a result of financial difficulties

Agriculture's use of technology is mostly attributable to the industry's complexity, which includes little farm sizes and rural areas' absence of cellular infrastructure regions, heavy regulatory loads that drive up expenses, with minimal income due to consumers' possession of the means and readiness to pay.

History of AI in agriculture

In the 1980s, research on using robots for agriculture commenced, and Japan was the first country to produce a pesticide-spraying robot. Recognising that navigating in actual agricultural environments is difficult, a research team created the autonomous mobile robot known as AURORA in 1996. This robot could navigate in greenhouses on its own or be controlled remotely while carrying out specific tasks that would have traditionally required a lot of manual labour. Actually, human operators are susceptible to pesticides, fungicides, and other chemical products, particularly in the warm and poorly ventilated greenhouse environment, which can lead to skin diseases, chronic illnesses, and even death. This was the original driving force behind the creation of robots specifically designed for the greenhouse environment.

An early example of an agricultural robot is a tractor that uses machine vision to follow a crop line by receiving an input from the global positioning system (GPS), or more precisely, a software that indicates the path to be travelled.

AI application in Agriculture

1. Soil Management

One of the most critical components of a productive agricultural system is a fertile soil. As the first source of nutrients, soil retains essential elements such as water, nitrogen, phosphorus, potassium, and proteins for optimal crop growth and development. Compost and manure can increase soil aggregation and porosity. They can also prevent soil physical deterioration by using an alternate tillage strategy. Negative elements like contaminants and pathogens that are carried by the soil, for instance, might be reduced with proper management of the soil. AI is also useful in creating soil maps, which illustrate the interactions between soil and landscape as well as the different layers and amounts of soil below the surface.

2. Weed management

One of the factors that most lowers a farmer's predicted profit is weeds. For instance, if weed invasion is allowed to spread, dried bean and maize crops may lose 50% of their yield, and wheat production may be reduced by 48% due to weed competition, potentially though certain weeds are harmful and potentially pose a health risk to the public, weeds nevertheless compete with crops for resources like water, nutrients, and sunshine. Although spray is frequently used to suppress weeds, excessive use of it can contaminate the environment and have a harmful effect on human health. Consequently, in order to save expenses, artificial intelligence weed detecting systems have been tried in labs to determine the correct amount of spray to use and to spray on the target spot properly.

3. Yield Prediction and Crop Monitoring

Machine learning algorithms process historical and real-time data to predict crop yields and monitor plant health, allowing for timely interventions and better resource allocation.

Challenges of practical application of AI in agriculture

Possible uneven future distribution of mechanization

Mechanisation may be unevenly distributed, with certain places lacking access to resources and conditions that cannot be changed by scientific discoveries and technical advancement.

Some discrepancies can occur in actual and control experiments

Images vary from control situations due to factors including illumination, backdrop complexity, and taking angle. Furthermore, grains grown in the field, irrespective of the same region, are physically varied. The effects of other components such as insects, soil, and inert matter. In the scenario, the physiological characteristics of individuals add to the variety of factors to consider during processing images, hence a bigger and more diversified collection of control data was necessary to increase the current classification accuracy.

Security and Privacy concerns

Physical equipment, including IoT, are vulnerable to hardware attacks because they may be left unsupervised for extended periods of time. Typical security counter measurements include data encryption, tag frequency modification, tag deletion policy, and use of blocker tags. Location-based services are vulnerable to device capture attacks, which allow attackers to extract cryptographic implementations and get limitless access to data stored on the device. Attacks can occur when data is sent from the device to the gateway and then uploaded to cloud infrastructures.

Conclusion

In conclusion, AI is revolutionizing agriculture by enabling smarter, data-driven decisions, improving efficiency, and fostering sustainability, ultimately contributing to global food security and environmental conservation.

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