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ARTIFICIAL INTELLIGENCE IN AGRICULTURE: A PATH TO THE FUTURE

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Agriculture, an age-old and vital industry, is facing a monumental challenge. The United Nations predicts that the global population will surge to 8.5 billion by 2030 and 9.9 billion by 2050, leading to an urgent need for innovative solutions. To meet the escalating demands for food and labor, we must embrace new automated methods (Zhang et al., 2021). With the evolution of technology, we are on the cusp of combining human and artificial intelligence to enhance our cognitive abilities (Bhat & Huang, 2021). This groundbreaking research has paved the way for the emergence of artificial intelligence, empowering us to create intelligent machines (Jha, Doshi, Patel, & Shah, 2019). The progress of agriculture hinges on the integration of advanced technologies such as AI, IoT, machine learning, blockchain, and more across all sectors to ensure sustainable productivity (Bannerjee, Sarkar, Das, & Ghosh, 2018). AI is a linchpin in numerous industries, including agriculture, finance, industry, and medical science. Our primary focus is on AI in agriculture, recognizing its pivotal role in developing economies and its potential to generate work opportunities for billions of people worldwide.

Applications of Artificial Intelligence in Agriculture

Embracing the rapid evolution of artificial intelligence is crucial for the advancement of multiple sectors in the global economy (Vyas, Shabaz, Pandit, Parvathy, & Ofori, 2022). With improved processing capabilities and precision in weather prediction, AI techniques offer invaluable benefits **(Figure 1)**. Precision agriculture empowered by AI can revolutionize resource consumption and crop management, leading to a more sustainable and efficient agricultural environment (Karunathilake, Le, Heo, Chung, & Mansoor, 2023).

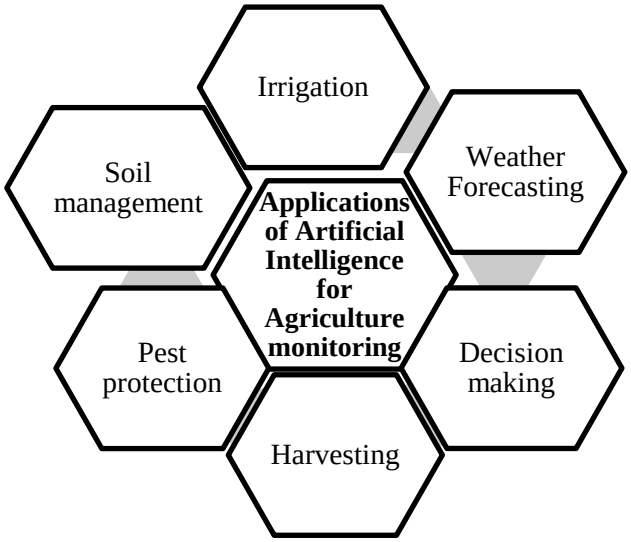

Fig. 1: Applications of AI for agricultural monitoring

Source: (Javaid, Haleem, Khan, & Suman, 2023)

Benefits of Artificial Intelligence

- ***Crop Monitoring, Pests, and Disease Detection in Precision Farming:*** Experience the future of farming with precision agriculture, harnessing the power of AI technology to accurately detect plant pests, diseases, and nutritional deficiencies on farms (Nawaz, Nadaf, Kareem, & Nagaraja, 2020). Plantix is an advanced German software application that effectively identifies soil flaws, nutrient deficits, as well as plant pests and diseases (Grace, Salvatier, Dafoe, Zhang, & Evans, 2018).
- ***Cost reduction:*** Implementing automation in Indian agriculture has resulted in significant cost savings. Utilizing agri-bots for crop maintenance, harvesting, and weeding has proven to substantially decrease fertilizer expenses and lessen the dependency on human labor.
- ***Predictive Analytics:*** Harnessing the power of AI, advanced algorithms thoroughly evaluate past data and environmental conditions to accurately forecast agricultural yields, assess market demand, and pinpoint the best times for planting. This invaluable insight empowers farmers to make well-informed decisions, leading to enhanced planning and increased profitability.

Drawbacks of Artificial intelligence

- ***High Initial Cost:*** In developing countries, the majority of farmers are small-scale and lack the resources to invest in this technology due to its high cost. This hinders their ability to improve efficiency and productivity in their operations.
- ***Employment reduction:*** While AI technology offers significant time and cost savings, it has led to widespread unemployment as the population continues to grow exponentially.
- ***Lack of Skills:*** The majority of farmers in developing nations struggle with illiteracy, which hinders their ability to acquire and utilize modern technologies.
- ***Requires Big Data:*** AI systems rely on extensive data to develop accurate predictions. While gathering spatial data for agricultural land is relatively straightforward, obtaining temporal data can be more challenging. Crop-specific data is often limited to the growing season, available only once a year. Constructing a powerful machine-learning model requires significant time and effort due to the gradual refinement of the data infrastructure.

Future Scope

AI technology offers groundbreaking solutions to crucial agricultural issues impacting farmers globally. By providing advancements in pest and disease management, weather prediction, and farm work support, AI presents a compelling opportunity to revitalize the agricultural sector. Furthermore, embracing AI in farming can attract a new generation to the profession, generating employment opportunities in various nations. However, AI in agriculture must focus on universal accessibility, as the current technology is predominantly utilized by large, well-connected farms.

Establishing connections with small farms in remote locations across the globe is vital to ensuring the future prosperity of AI-driven agricultural innovations and data science in farming. By harnessing future technological advancements, businesses can enhance AI-based products and services, including training data for agriculture, drones, and automated manufacturing, addressing global food supply concerns for a growing population.(Javaid et al., 2023).

Conclusion

AI-enabled solutions utilize various data inputs such as temperature, precipitation, wind speed, and solar radiation. By integrating this data with advanced machine learning algorithms and satellite/drone photos, these solutions effectively assess agricultural sustainability and thoroughly analyze farms for pests, diseases, and poor plant nutrition. Artificial intelligence (AI) significantly enhances agricultural processes and offers valuable assistance to farmers in tackling challenges related to climate change, pests, diseases, weed infestations, and low harvests.

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