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Revolutionisation of Agriculture With Smart Science – AI

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ABSTRACT:

Artificial Intelligence (AI) has been making a significant impact in all sectors across the globe. Agriculture and farming are among the world's ancient and most important professions and are also very important for the economic sector and the research in artificial intelligence is very specialized and sophisticated. Technology has revolutionized farming throughout the years, and it has several consequences for the agricultural industry. Agriculture is the primary sector in many nations worldwide.

The global populace is expected to exceed 10 billion by 2050 according to the United Nations FAO (Food and Agriculture Organization), putting such tremendous pressure on agriculture, that the conventional techniques employed by farmers are insufficient to meet these needs. To expand food production and maximize yields the contribution of AI for the emergence of new methodologies is highly essential for improving the productivity of current farmland.

AI can improve the present agricultural techniques, from the very early action of soil testing to yield analysis, AI has substantially enhanced its quality at every stage of agriculture. The main concern of this paper is to present the significance of artificial intelligence (AI) in the agricultural sector. It also focuses on the challenges and concepts generated by AI that are foreseen for a sustainable future. The paper discusses the use of AI for crop and soil monitoring, automated irrigation systems, disease and pest detection, spraying, and other AI applications.

With the use of AI technology, crop output will be protected against several threats, including biotic and abiotic variables, concerns with food security, and climate change. This technology reduces the need for excessive amounts of water, pesticides, and herbicides, preserves soil fertility, aids in the effective use of labor, increases productivity, and enhances quality.

Key Words: Agriculture, artificial intelligence, productivity, yield analysis, breeding.

Introduction:

According to the Food and Agricultural Organization of the United Nations among the total 37.6% of global land surface only one-third of it is used for crop land and the remaining two-thirds is used for grazing of livestock. The agriculture industry is in threat due to the world's rapidly growing population, but artificial intelligence (AI) may be able to provide much-needed relief. Farmers can now produce higher yields with less input via AI-based technology solutions, which have also enhanced the quality of the output and accelerated up the time it takes for the harvested crops to reach the market.

Artificial Intelligence is a new technology in agriculture. AI-powered machinery and equipment have raised standards for today's agricultural sector. Crop output has increased through advances in technology, which has also improved real-time harvesting, processing, marketing, and monitoring. AI methods will surely advance farming operations and present a challenge to established methods of decision-making. The lives of farmers will most likely be better in every manner as a result of these technical developments, and agricultural practices and yields will most likely also improve.

Applications Of Ai In Agriculture:
Crop And Soil Monitoring:
 Analysing soil and crop health is crucial, as an imbalanced nutrient composition can significantly impact crop growth. AI plays a pivotal role in this process, utilizing computer vision models to precisely monitor soil conditions and collect reliable data. By identifying specific nutrients and understanding their influence on crop yield, farmers can easily implement necessary adjustments for optimal results.

Unlike human observation, which may be prone to inaccuracies, AI-driven systems excel in providing detailed insights. These insights extend beyond nutrient analysis to include comprehensive plant science data, enabling the prediction of crop yields and early detection of potential issues. Notably, AI demonstrates exceptional speed and accuracy in tracking wheat growth stages and assessing tomato ripeness, surpassing human capabilities in these tasks. This technological advancement empowers farmers with efficient tools for crop and soil management, enhancing overall agricultural productivity.

Precision farming and predictive analytics:
AI applications in agriculture have evolved to offer precision farming solutions, empowering farmers with accurate guidance on water management, crop rotation, timely harvesting, optimal planting, and nutrition management. These tools leverage machine learning algorithms in conjunction with satellite and drone-captured images to predict weather conditions, assess crop sustainability, and detect diseases or pests. By analysing data such as temperature, precipitation, wind speed, and solar radiation, these AI-enabled technologies provide comprehensive insights for informed decision-making in agriculture. The integration of predictive analytics enhances the efficiency and control of farming practices, contributing to sustainable and productive agriculture.

Optimizing automated irrigation systems:
Leveraging AI algorithms facilitates the automation of irrigation systems in agriculture. When integrated with sensors, which actively track soil moisture levels and weather conditions, these algorithms can dynamically determine the precise amount of water needed for crops in real-time. The implementation of such autonomous crop irrigation systems not only conserves water but also aligns with the principles of sustainable farming, showcasing a commitment to resource efficiency and environmental responsibility.

Furthermore, these advanced irrigation systems operate seamlessly by continuously adapting to the evolving needs of the crops. By processing data from sensors and making instantaneous decisions, AI-driven algorithms ensure that the irrigation process is optimized for each specific field, enhancing the overall efficiency of water usage. This dynamic responsiveness to environmental factors contributes to the conservation of water resources and minimizes the environmental impact associated with traditional irrigation practices.

The integration of AI and IoT (Internet of Things) in automated irrigation systems marks a transformative shift in agricultural practices. The synergy between these technologies not only streamlines operations for farmers but also plays a crucial role in addressing the global challenge of water scarcity. As these smart irrigation systems become more widespread, the agricultural sector is poised to embrace a sustainable and technologically advanced future, where precision and resource conservation go hand in hand.

Detecting diseases and pests:
In addition to assessing soil quality and monitoring crop growth, computer vision proves invaluable in identifying the presence of diseases and pests in agriculture. This process involves AI-driven image analysis, which scans for signs of mould, rot, insects, and other threats to crop health. The integration of alert systems enhances the responsiveness of farmers, enabling swift actions to exterminate pests or isolate crops, thereby

curbing the spread of diseases.

The capabilities of AI in disease and pest detection are exemplified by its remarkable accuracy, surpassing 90% in identifying apple black rot and various insects such as flies, bees, and moths. This high precision underscores the effectiveness of leveraging machine learning algorithms for proactive agricultural management. However, it's noteworthy that achieving such accuracy required researchers to amass a comprehensive dataset of images, emphasizing the importance of robust training data to refine and optimize these detection algorithms.

As technology continues to advance, the application of AI in identifying and mitigating threats to crop health becomes increasingly sophisticated. The success in detecting specific diseases and pests showcases the potential for these systems to revolutionize pest management strategies, providing farmers with a powerful tool to safeguard their crops and optimize overall agricultural productivity. The ongoing refinement of AI algorithms, coupled with expanded datasets, holds the promise of further elevating the accuracy and scope of disease and pest detection in agriculture

Challenges In Adoption Of Ai For Agriculture:
- Despite all of the potential that AI offers for applications in agriculture, there is still a lack of knowledge about sophisticated, high-tech machine learning solutions in farms all over the world
- Large amounts of data are also needed by AI systems in order to train robots and make accurate forecasts or predictions.
- The different crop-specific data could only be acquired throughout the growing season once a year. Building a strong AI machine learning model requires a significant amount of time, as the database takes time to develop. This is one of the main reasons AI is used in agronomic goods rather than on-field precision solutions, such as seeds, fertilizer, and insecticides.
- Even though using AI to agriculture has several advantages, most people globally are not aware with the use of AI-enabled tools and solutions. In order to address the problems, AI businesses ought to initially provide farmers simple equipment, and then, as they become accustomed to it, more sophisticated machinery.
- For developing countries, implementing AI and other cutting-edge technologies in agriculture might be difficult. In places where such agricultural technology is not being used, it will be extremely difficult to sell such technologies. To apply these technologies in these places, farmers require assistance from someone.
- AI may give rise to a number of legal concerns because there are currently no defined rules and guidelines for its use. Furthermore, there can be security and privacy problems like cyber-attacks and data leaks because of the usage of software and the internet. For farmers or farm owners, all of these problems could pose serious challenges.

Conclusion:

- The acceptance of AI solutions will determine how farming uses AI in the future. In addition to helping farmers it automate tasks,by use drones to efficiently apply pesticides and herbicides on their farms, and plant monitoring is no longer a hardship. The use of AI in agriculture is enabling more precise cultivation, which uses fewer resources to produce higher-quality and higher-yield crops.
- The agricultural sector has to deal with a number of obstacles, including ineffective irrigation systems, weeds, difficulties monitoring plants because of crop height, and harsh weather. However, technology can

help to improve performance, which means that these issues can be resolved. Several AI-driven methods, such as remote sensors for detecting soil moisture content and GPS-assisted autonomous irrigation, can be used to improve it.

• AI would undoubtedly help farmers automate and computerize the processes involved, shifting the focus toward accuracy that produces outstanding quality and desirable yields while using less resources. As technology develops, more useful applications in this field will become accessible, assisting the global community in addressing challenges associated with food production for an expanding population.

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