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LITERATURE SURVEY on AI in AGRICULTURE

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Abstract: The integration of Counterfeit Insights (AI) in farming has revolutionized traditional cultivating hones by upgrading productivity, productivity, and maintainability. This literature overview investigates the different AI procedures and their applications in horticulture, counting crop observing, bug discovery, abdicate expectation, and exactness cultivating. Through a comprehensive survey of later ponders, we highlight the headways, challenges and prospects of AI in agriculture.

Keywords: Artificial Intelligence, Agriculture, Precision Farming, Crop Monitoring, Yield Prediction, Pest Detection

I. INTRODUCTION

Horticulture faces challenges like climate change, pest infestations, and resource limitations, impacting global food security. AI offers innovative solutions by analyzing vast data, predicting outcomes, and aiding informed decisions. Applications of AI include climate adaptation through localized forecasts, pest and disease management with real-time monitoring, and precision farming for optimized resource use. AI -driven systems enhance irrigation, fertilizer application, and labor efficiency. Automated harvesting and sorting technologies also reduce costs and crop damage.

II. BASIC CONCEPTS

A. Machine Learning

Machine learning, a subset of AI, involves preparing calculations to learn from information and make expectations. In agribusiness, ML is utilized for yield forecast, edit infection discovery, soil health evaluation, and indeed advertise cost forecasting. Methods like back vector machines (SVM), neural systems, and choice trees are commonly utilized. For occurrence, recent ponders have illustrated the adequacy of deep learning models in foreseeing edit yields with tall exactness by analysing verifiable surrender data and natural conditions.

B. Computer Vision

Computer vision innovation empowers the analysis of pictures and recordings to screen trim health, distinguish bugs, and evaluate plant development. Drones and obsequious symbolism are frequently utilized to capture high -resolution images, which are then handled utilizing convolutional neural networks (CNNs) for exact investigation. This innovation has demonstrated especially compelling in large-scale cultivating operations. The integration of artificial intelligence in image analysis ensures that farmers can receive actionable data in real-time, enabling prompt interventions to protect and enhance crop yields.

C. Robotics

Mechanical autonomy AI-powered robots are utilized for assignments such as planting, weeding, and collecting. These robots are prepared with sensors and cameras to explore areas, recognize crops, and perform exact agrarian operations, decreasing the require for manual labor. Progresses in mechanical autonomy have driven to the ad vancement of independent tractors and mechanical collectors, which enhance efficiency and decrease the physical strain on ranchers.

D. Internet of Things (IoT)

Web of Things (IoT) The integration of AI with IoT gadgets has empowered real-time checking and management of agrarian forms. IoT sensors collect information on soil dampness, temperature, humidity, and supplement levels, which is at that point analyzed by AI calculations to give noteworthy experiences. This cooperative energy between AI and IoT encourages precision farming, permitting agriculturists to optimize asset utilize and make strides trim yields.

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E. Natural Language Processing (NLP)

Characteristic Dialect Handling (NLP) NLP methods are utilized to analyze unstructured information such as climate forecasts, showcase reports, and investigate articles. AI frameworks can extricate pertinent data from these sources to help ranchers in decision making. For illustration, NLP can offer assistance in the advancement of chatbots and virtual assistants that give ranchers with convenient counsel and back based on real-time information.

III. APPLICATIONS OF AI IN AGRICULTURE

A. Crop Monitoring and Management

Edit Checking and Administration AI frameworks analyse information from sensors and satellites to screen edit wellbeing, soil conditions, and climate designs. This data helps ranchers make opportune choices approximately irrigation, fertilization, and bug control, optimizing asset utilize and expanding trim yields. UAV based frameworks were assessed [7] for airborne crop wellbeing monitoring.

B. Pest and Disease Detection

Bother and Illness Detection Early discovery of bugs and infections is crucial for anticipating trim misfortunes. AI models prepared on picture datasets can distinguish indications of various plant illnesses and bug invasions. This allows for incite intercession, lessening the dependence on chemical pesticides. Profound learning methods were investigated [2] for exact trim monitoring and illness distinguishing proof. For instance, analysts have created AI frameworks that can identify plant infections with over 90% accuracy, empowering ranchers to apply focused on medicines.

C. Livestock Management

AI applications in animals' administration include observing creature wellbeing, following movements, and analyzing bolstering designs. Machine learning calculations can anticipate maladies, optimize feeding plans, and move forward by and large creature welfare. Cleverly frameworks were proposed [5] for improved animals observing and management.

D. Yield Prediction

Surrender Prediction Precise surrender forecast models help farmers arrange their harvests and oversee supply chains. ML calculations analyse chronicled surrender data, climate conditions, and soil wellbeing to forecast edit yields, empowering way better advertise arranging and asset assignment. Later progressions in ML have progressed the exactness of abdicate predictions, Machine learning applications were checked on [6] for abdicate expectation and soil administration.

E. Precision Farming

Exactness Cultivating Precision cultivating includes the utilize of AI to oversee areas at a small-scale level. Sensors and IoT gadgets collect real-time information on soil moisture, supplement levels, and trim development. AI algorithms analyze this information to give suggestions for site-specific administration hones, improving productivity and sustainability. AI-driven computerization was evaluated [8] for precision farming and savvy edit systems.

F. Supply Chain Optimization

Supply Chain Optimization AI innovations are moreover connected to optimize agrarian supply chains, from cultivate to table. By analyzing information on trim generation, market request, and coordination, AI frameworks can enhance supply chain productivity, diminish squander, and guarantee opportune conveyance of new deliver. This application is especially vital in reducing nourishment squander and progressing nourishment security. AI applications are examined [3] for optimizing rural supply chains, such as improving coordination and lessening squander in produce distribution.

G. Automated Irrigation Systems

Robotized Water system Systems AI-based water system frameworks utilize information from soil dampness sensors and climate estimates to optimize water utilization. These frameworks can foresee the best times to flood, and the amount of water required, in this manner preserving water and guaranteeing ideal edit development. Robotization using AI was inspected [4] for keen irrigation frameworks, counting versatile watering schedules based on real-time soil dampness data.

H. Soil Health Monitoring

Soil health is crucial for sustainable agriculture. AI systems analyze data from soil sensors to assess nutrient levels, pH, and microbial activity. This information helps farmers make informed decisions about soil management practices such as fertilization and crop rotation. Machine learning approaches were discussed [10] for soil health monitoring, focusing on analyzing soil properties and predicting nutrient needs.

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I. Weather Forecasting and Climate Adaptation

Climate Determining and Climate Adaptation AI can essentially upgrade climate forecasting and climate adjustment techniques in agriculture. By analyzing tremendous sums of meteorological data [1], AI models can give precise and localized climate forecasts. These estimates help agriculturists arrange planting and collecting schedules, moderate the dangers of extraordinary climate occasions, adjusting irrigation systems, or altering soil management techniques to cope with new climate conditions and adjust to changing climatic conditions.

IV. CHALLENGES AND FUTURE PROSPECTS

A. Data Quality and Availability

Information Quality and Availability The viability of AI models depends on the quality and amount of information. In agribusiness, data collection can be challenging due to the inconstancy of natural conditions and the need of standardized information designs. Addressing these issues requires the improvement of robust information collection strategies and the establishment of information sharing systems. Analysts from have been working on making standardized datasets and creating calculations to handle boisterous and deficient information .

B. Adoption and Cost

Selection and Cost The appropriation of AI advances in horticulture is ruined by tall costs and the require for technical mastery. Small- scale agriculturists, in specific, may battle to contribute in progressed AI frameworks and require preparing to viably utilize these innovations. Endeavors to create cost-effective AI arrangements and give preparing programs are fundamental to overcome these boundaries.

C. Ethical and Environmental Considerations

Moral and Natural Considerations The utilize of AI in agribusiness raises ethical concerns with respect to information security and the potential natural effect of robotized systems. Guaranteeing maintainable and mindful AI hones is basic for the long-term practicality of these technologies. Researchers and policymakers must work together to establish rules and controls that address these concerns.

D. Future Directions

Future Directions Future investigate ought to center on developing reasonable and user- friendly AI arrangements tailored to the needs of smallholder ranchers. Additionally, headways in sensor innovation, data integration, and machine learning calculations will upgrade the exactness and adaptability of AI applications in horticulture. Collaborative efforts between analysts, industry, and government organizations are vital for driving advancement and guaranteeing the broad selection of AI in horticulture.

E. Training and Capacity Building

Training and capacity building are essential for the successful adoption of AI in agriculture. Farmers and agricultural professionals must be educated about the benefits and applications of AI tools to use them effectively. Conducting workshops and training programs can provide hands-on experience with AI technologies like sensors, drones, and predictive analytics. Extension services can play a vital role in bridging the gap between technology developers and farmers, offering personalized guidance.

Developing educational materia ls in local languages enhances accessibility, ensuring that farmers understand and can apply AI solutions. Simplifying complex concepts makes AI more approachable for rural communities. Collaborative efforts between governments, NGOs, and technology providers can scale these initiatives. By empowering them with knowledge and skills, training efforts foster inno vation in farming practices. These initiatives also help in adapting AI solutions to local contexts, increasing their relevance and effectiveness in different agricultural environments.

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TABLE I Comparative Analysis of Research Papers

Reference Number	Research Work/Paper	Author/Year	Techniques	Experiments/ Observations	Remarks
[1]	Machine learning in agriculture: A review	Liakos, Busato, Moshou, D. / 2018	Supervised, Unsupervised, Reinforcement Learning	Crop yield, Soil management, Disease detection	Increased efficiency, Challenges in data and scalability
[2]	Deep learning in agriculture: A survey	Kamilaris , Prenafeta-Boldú / 2018	Deep Learning	Image analysis, Yield prediction, Disease detection	Promising results, Need for large datasets
[3]	Application of Artificial Intelligence in Agriculture	Bhagat, Mohan / 2020	Machine Learning	Pest control, Crop monitoring, Irrigation systems	Broad applications, Implementation complexity
[4]	Review on automation in agriculture using AI	Jha, Doshi, A, Patel, P / 2019	Automation	Robotic systems, Smart farming	Enhanced productivity, High initial costs
[5]	Intelligent agricultural systems based on AI: A review	Sun, Y., Du, W., & Zheng, F / 2017	Intelligent Systems	Crop monitoring, Soil analysis, Automation	Improved decision making, Technological barriers
[6]	Machine learning and its applications in agriculture: A review	Shirsath, Aggarwal / 2017	Machine Learning	Yield prediction, Disease detection, Soil management	Effective applications, Need for integration
[7]	UAV-ba sed crop	Pantazi, Moshou, Bochitis /2016	UAV, Remote Sensing	Crop health monitoring,	High accuracy, Regulatory challenges
	monitoring: A review			Aerial imaging	
[8]	Automation in agriculture by using AI: A review	Saleem, Arif K M, Potgieter/2019	Automation, Robotics, Smart Systems	Precision agriculture, Robotics, Smart systems	Increased efficiency, Initial setup costs
[9]	Precision agriculture— a worldwide overview	Zhang ,Wang 2002	Precision Agriculture, Technology	Variable rate technology, Data management	Global impact, Technological advancements
[10]	Machine learning approaches in precision agriculture: A review	Rehman, Naeem 2020	Machine Learning, Precision Agriculture	Yield prediction, Disease detection, Crop management	Sustainable practices, Data dependency

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V. FUTURE SCOPE

A. IoT Integration and Real-Time Monitoring

The combination of Internet of Things (IoT) devices with AI systems can provide real-time data on soil health, crop conditions, and weather. Advanced sensors connected through IoT can transmit data to cloud -based AI platforms, enabling predictive analysis and instant decision- making. This will further enhance precision agriculture practices.

B. AI-Driven Sustainable Agriculture

AI systems can help optimize the use of resources such as water, fertilizers, and pesticides, promoting eco -friendly and sustainable farming. Future AI models will focus on reducing carbon footprints and creating climate-resilient crops to mitigate the effects of climate change. AI-driven systems, however, provide the ability to make data -driven decisions that maximize efficiency.

C. Automation and Robotics

Autonomous farming machinery powered by AI is expected to play a critical role in large-scale agriculture. Robotic systems for planting, harvesting, and crop monitoring will increase operational efficiency, reduce labor dependency, and minimize waste.

D. Advanced Crop Breeding and Genomics

AI and ML algorithms can analyze vast datasets in genomics to accelerate the development of high -yield, disease-resistant, and climate- resilient crops. AI-driven insights will help in understanding genetic markers and optimizing breeding programs.

E. Enhanced Predictive Analytics

Future advancements in predictive analytics will allow farmers to anticipate challenges such as pest outbreaks, disease spread, and extreme weather events with higher accuracy. The integration of satellite imagery, remote sensing, and AI will improve disaster preparedness and risk management.

F. Blockchain for Transparent Supply Chains

AI-powered blockchain systems will ensure transparency in agricultural supply chains, enabling traceability from farm to fork. These systems will improve food safety, reduce waste, and ensure fair pricing for farmers.

G. Personalized Advisory Systems

AI-driven platforms will evolve to provide personalized recommendations to farmers based on local conditions, crop types, and market trends. Multilingual and voice-based interfaces will make these systems accessible to farmers in remote areas.

H. Integration of Virtual and Augmented Reality

The use of virtual reality (VR) and augmented reality (AR) in agriculture can revolutionize training, equipment handling, and farm monitoring. AI-enhanced AR systems can provide farmers with real-time data overlays on crop health and farming operations.

I. Global Collaboration for Open AI Models

Collaborative efforts to develop open-source AI models for agriculture will democratize technology access, especially in developing countries. These models can be fine-tuned for local conditions, fostering innovation and growth in agriculture worldwide.

J. AI-Powered Climate Resilience

As climate change intensifies, AI systems will be essential for modeling and mitigating its impact on agriculture. Future tools will provide farmers with adaptive strategies to cope with changing environmental conditions, ensuring food security globally.

K. Robotic Weeding and Planting

AI-powered robots can autonomously detect and remove weeds, reducing the need for herbicides and minimizing soil disturbance. These robots can also plant seeds with precision, ensuring optimal spacing and depth for healthy crop growth. By automating these labor-intensive tasks, farmers will reduce their reliance on chemical treatments and improve soil health, leading to more sustainable farming practices benefiting both the environment and human health.

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VI. CONCLUSION

This orderly audit, conducted utilizing the PRISMA (Preferred Reporting Systematic Reviews Items for and Meta - Analyses) strategy, pointed to distinguish major and recent counterfeit insights (AI) advances connected in horticulture. It identified seven primary agrarian applications: edit management, water management, soil management, fertigation, trim expectation, trim classification, and disease/pest administration. Furthermore, it highlighted twenty - four distinctive AI techniques, with machine learning, profound learning, mechanical technology, and the Web of Things being the most frequently used. The audit found that AI advances are optimizing rural administration systems, water system practices, and disease/pest recognizable proof. Be that as it may, challenges incorporate the tall taken a toll of equipment and program, which remains restrictive for numerous little and medium rural makers, and the require for qualified labor. The survey moreover famous the utilize of computer vision with mechanical technology and unmanned ethereal vehicles (UAVs) for trim classification and disease/pest recognizable proof. Rising advances such as advanced twins are promising for prepare optimization. Terms like accuracy agribusiness and systems such as shrewd cultivating, farming 4.0, and agriculture 5.0, which coordinated AI and UAVs, are progressively relevant. Impediments of the audit incorporate the center on English-language academic diaries and potential inclinations in think about choice.

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