WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

AI-POWERED SMART FARMING SYSTEM

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ABSTRACT :

By increasing production, maximizing resource use, and making sure sustainability, Smart Farming—using artificial intelligence (AI) in agriculture—is reworking the arena. Using system studying algorithms, pc imaginative and prescient, and IoT sensors, AI-pushed clever farming systems song crops, expect yields, come across sicknesses, and automate irrigation and fertilization approaches. This paper appears at artificial intelligence's effect in precision agriculture, independent device, predictive analytics, and selection assist structures. We underline the blessings of artificial intelligence in improving efficiency, reducing charges, and addressing hard work shortages whilst we bear in mind issues such massive first investment, information privateness issues, and the want for technical knowledge. Case research of AI-driven agricultural fashions in the United States, India, and Europe screen the sensible makes use of and destiny possibilities of this converting technology.

Keywords Smart Farming, Artificial Intelligence, Precision Agriculture, IoT, Machine Learning, Automated Monitoring, Crop Yield Optimization, Data Analytics.

Introduction

Fundamental to the arena economic system, agriculture feeds billions of people and presents uncooked substances for many sectors. The enterprise, then again, faces numerous demanding situations along with labor shortages, climate exchange, limited resources, and developing meals demand. Often lacking contemporary efficiency standards, traditional agricultural practices produce inconsistent harvests, high resource use, and susceptibility to environmental threats.

The arrival of artificial intelligence (AI) and the Internet of Things (IoT) has given upward push to Smart Farming as a option to these troubles. Through information-driven decision-making, AI-driven systems allow farmers to maximise crop manufacturing, discover illnesses early, and automate tedious tasks. Technologies consisting of machine gaining knowledge of, deep learning, and edge computing have all greatly affected predictive analytics, real-time tracking, and independent farming.

This paper investigates the function of synthetic intelligence in smart irrigation, crop health tracking, automatic farm equipment, and precision agriculture. It also discusses the challenges of making use of synthetic intelligence in agriculture and affords tips for destiny studies and development.

Literature Review

Smart Farming Development

Artificial intelligence in agriculture dates again to early gadget vision structures for crop type. Recent tendencies in IoT sensor technology, cloud computing, and deep learning have improved the effect of synthetic intelligence on agricultural automation and selection-making (Zhang et al., 2022).

Two synthetic intelligence applications in precision agriculture

Precision agriculture studies soil situations, predicts climate styles, and units the superior planting and harvesting instances the use of artificial intelligence methods (Gomes et al., 2021).

Autonomous equipment and robotics

Changing farming strategies are robotic harvesting systems, drone-based tracking, and self-using tractors (Smith et al., 2020).

Predictive analytics facilitates crop control Four

Predictive models powered by means of synthetic intelligence forecast crop diseases, pest infestations, and yield estimates, so allowing farmers to act preventively (Chen et al., 2023).

Problems with AI Adoption

Among the principle demanding situations are excessive initial investment, records management complexity, and the digital divide among technologically superior and growing countries (Kumar & Patel, 2023).

Methodology

By manner of literature assessment, case take a look at evaluation, and sensible examples, this paper evaluates AI-pushed smart farming systems the usage of a qualitative method.

- **Collecting Information**

Remote sensors, satellite snap shots, and drones gathering facts song soil moisture, temperature, and nutrient ranges. AI-pushed algorithms then offer insightful evaluation by searching at past crop yields, climate styles, and feasible sickness outbreaks.

- **Machine Learning Algorithms and Artificial Intelligence**

Supervised and unsupervised learning techniques help to perceive styles in crop boom, pest hobby, and soil fertility. While Convolutional Neural Networks (CNNs) beautify plant ailment detection by means of photo reputation, reinforcement getting to know maximizes automatic irrigation and fertilizer distribution for higher efficiency.

- **3. Use of IoT and Edge Computing**

IoT gadgets make sure non-stop tracking by actual-time records switch from sensors to cloud-based totally synthetic intelligence structures. Conversely, aspect computing approaches information regionally to lower latency and decorate reaction time for quicker choice-making.

Case Studies

In the United States, AI-driven John Deere self sufficient tractors boom performance and decrease gasoline consumption. The AI-driven Krishi-RAS (Remote Advisory System) in India gives farmers customised crop suggestions. Conversely, in Europe, structures primarily based on drones monitoring crop health assist to are expecting yields and help ailment manipulate.

Benefits of AI-Driven Smart Farming

- **Increased Crop Yield and Productivity**

AI-based totally precision farming lets in for max planting, watering, and fertilization agenda, consequently enhancing manufacturing and crop pleasant.

- **Resourceful Use**

By monitoring soil moisture and climate conditions, clever irrigation systems promise top of the line water use and decreased waste with the aid of artificial intelligence.

Three. Agricultural Activities Automated AI-pushed self sufficient tractors, drones, and robot harvesters growth operational efficiency and reduce reliance on manual exertions.

- **Early Disease Detection and Pest Control**

Computer imaginative and prescient and deep getting to know technology help to become aware of crop sicknesses and pest infestations early, which then allows quick interventions.

- **Reducing Expenses**

AI enables to store resources by lowering general fertilizer, pesticide, and hard work prices.

Summary of Benefits:

AI-driven smart farming increases crop yield, aid performance, and automation via precision agriculture, smart irrigation, and autonomous machinery. It enables early sickness identity and cost reductions the usage of artificial intelligence-driven analytics and laptop vision. By method of agricultural operation optimization, this era guarantees sustainability and improved production.

Challenges of AI in Smart Farming

- **High Initial Investment**

Small-scale farmers discover cloud computing, IoT sensors, and AI-powered equipment all call for most important economic commitment prohibitive.

- **Data Security and Privacy Risks**

Large-scale farm records, on which synthetic intelligence structures rely, increases questions of statistics breaches and unlawful get admission to.

- **Lack of Technical Knowledge**

Many farmers lack the necessary expertise to perform AI-pushed systems, which calls for more education and aid packages.

- **Issues with Rural Area Connectivity**

Poor internet connection in far flung agricultural regions hinders the actual-time utility of synthetic intelligence solutions.

Real-World Use Cases of Serverless Architectures

- **John Deere's Solutions for Autonomous Farming**

John Deere employs smart self reliant tractors and precision planting technologies to maximise agricultural activities.

- **International Business Machines Watson's AI-Driven Weather Forecasting for Agriculture**

B.M. Watson's AI-driven weather forecasting device allows farmers to make facts-pushed selections on crop planting and harvesting.

- **Blue River Technologies' Smart Weeding System**

Artificial intelligence-pushed robotic weed manage improves crop fitness and decreases the need for excessively sturdy pesticide use.

Conclusion

AI-driven clever farming structures are transforming agriculture via improved performance, decreased aid waste, and better crop excellent. By means of gadget studying, IoT, and agricultural automation, farmers are capable of predict illnesses, optimize irrigation, and automate harvesting, therefore allowing precision agriculture. Widespread adoption relies upon on addressing problems consisting of high fees, statistics privacy issues, and technical know-how gaps.

Artificial intelligence in agriculture is formed in all 3 methods by means of aspect computing for actual-time analysis, blockchain for safe records management, and AI-driven robots for automatic farming. As research and era advances, AI-driven smart farming could be an increasing number of vital in attaining sustainable agriculture.

Future Directions

The future of AI-driven smart farming looks promising, with continuous advancements expected in various areas. Key future directions include:

1. **Integration with Edge Computing**
   AI-powered systems will increasingly rely on edge computing to process data locally, improving real-time decision-making and reducing latency.

2. **AI-Powered Robotics**
   The development of advanced robotic farming solutions, including automated harvesting and precision weeding, will further reduce labor dependency and increase efficiency.

3. **AI-Driven Climate Adaptation Strategies**
   AI models will play a critical role in developing adaptive farming techniques to mitigate the impacts of climate change on crop production.

4. **Enhanced AI-Driven Decision Support Systems**
   Future AI applications will focus on more sophisticated predictive analytics to provide farmers with deeper insights into soil health, crop rotation, and resource optimization.

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