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Precision agriculture using IOT and AI

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ABSTRACT:

Precision agriculture has become a game-changing method for contemporary farming methods by combining Internet of Things (IoT) and Artificial Intelligence (AI) technologies. In order to maximize resource use, boost crop yields, and lessen environmental effects, this research investigates the synergistic potential of IoT and AI in agricultural systems. Precision agriculture gives farmers never-before-seen opportunity to monitor and control crop growth conditions, automate chores, and carry out focused interventions. It does this by utilizing IoT sensors for real-time data collecting and AI algorithms for data analysis and decision-making. In an increasingly complex and dynamic agricultural landscape, this abstract highlights the importance of integrating IoT and AI in agriculture and highlights how it has the potential to transform practices and solve the issues of food security and sustainability. By enabling the tractors to guide themselves, precision farming technology also serves the primary purpose of simplifying the operator's life. Moreover, this may ensure that wheelings only take place in a strictly regulated region of the field and result in more exact and accurate applications and operations.

Keywords: Internet of Things (IoT), Artificial Intelligence (AI), IoT sensors, Precision agriculture, Food security

Main text

The introduction to precision agriculture with IoT and AI is provided in this study. Technology breakthroughs like the Internet of Things (IoT) and artificial intelligence (AI) have caused a paradigm change in agriculture in recent years towards precision agricultural methods. Precision farming seeks to maximize crop yield while reducing inputs like water, fertilizer and pesticides, improving sustainability and financial viability

1.1. Introduction

AI and IoT integration in agriculture has created new opportunities decision-making procedures, boosting productivity and lowering hazards related to conventional agricultural methods. An overview of precision agriculture is given in this introduction, along with an examination of how AI and IoT are transforming farming practices. IoT sensor placement in agricultural areas allows for ongoing monitoring of critical parameters, giving farmers early information to detect any problems like insect infestations, fertilizer shortages, or irrigation concerns. The massive volumes of data produced by these sensors are analysed by AI algorithms, which find patterns, correlations, and abnormalities that would not be noticeable to human observers. Additionally, precision agriculture makes it easier to apply site-specific management techniques, in which interventions are made to specifically address the requirements of certain fields or even.

Components of precision agriculture are:

- GPS & GIS
- VRT(variable rate technology)
- Remote sensing
- Data collection & analysis

Food production must increase in order to keep up with the world's population growth. By tailoring agricultural procedures to particular field circumstances, precision farming techniques enable farmers to optimize their production potential while assuring effective resource utilization. Precision farming can greatly increase crop yields while reducing resource waste by adjusting irrigation, fertilization, and other inputs to each crop's unique requirements. Conventional farming methods, like excessive water and chemical use, are frequently linked to detrimental environmental effects. Because precision farming allows for targeted input application, waste reduction, and environmental impact minimization, it presents a more sustainable method. Farmers may minimize the negative effects of pesticides and fertilizers on soil and water resources by using data-driven insights to optimize their application.

1.2. Precision agriculture vs Traditional farming

Accuracy in practical terms, agriculture and traditional cultivation are very different. In traditional agriculture, farmers regional guidelines for general suggestions when applying the same quantity of pesticides, fertilizers and irrigation to each field at the designated times and frequencies. Even within a single area, there are, nevertheless, always variations in the biological, physical and chemical characteristics. When fields are treated uniformly without taking into account intrinsic disparities, fertile land will receive an excessive amount of inputs, while poorer patches would receive less. The wasteful use of fuel, land, water, fertilizer, and pesticides raises expenses and has a negative impact on the environment.

1.3. VRA and GIS in precision farming

Variable Rate Application (VRA) is used in precision agriculture to maximize input while addressing the inherent variations in farmland. In order to apply VRA, comprehensive spatial data must be gathered from various fields and places utilizing remote sensing and GPS to track crop lifecycles and uses geographic information systems (GIS). Information management systems, yield mapping and monitoring tools, and precision irrigation systems are some of the instruments utilized in precision farming. Precision agriculture uses sophisticated descriptive, predictive, and prescriptive engines to evaluate the data and make data driven management decisions that enable the adoption of economical, environmentally sustainable, and modern farming practices. Real-time data on soil, crop, hyper-local weather predictions, equipment available and other variables are collected using developing technologies like satellite images, GPS-enabled instruments, and internet of things (IoT) enabled devices like drones and smart agricultural sensors.

Applications of GIS in agriculture for sustainable growth:

- Reduced costs
- Yield gain
- Time saving
- Chemicals control
- Better harvests
- Better farm management
- Increased land value

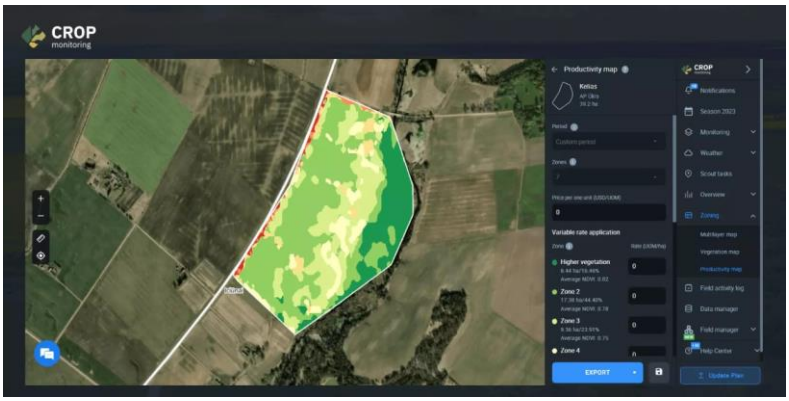

Figure 1 : GIS in precision farming

Global positioning system (GPS) for precision farming

Anywhere on or near earth, in any weather, the Global Positioning System (GPS) is a satellite-based navigation system that gives location and time information. GPS is utilized in precision agriculture to deliver accurate location data for mapping and navigation. Mapping and gathering data at the field level are two of the primary applications of GPS in precision agriculture. Farmers can gather information on the location, size and shape of their fields as well as the locations of certain features like fence lines, drainage ditches and irrigation systems by using GPS receivers installed on their vehicles or equipment. Field operations can be planned and scheduled using the detailed maps of the fields that can be made with this data.

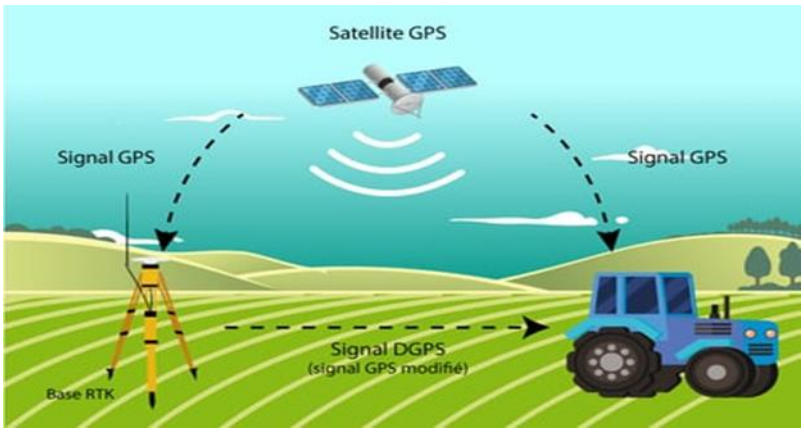

Figure 2 : GIS in precision farming

1.4. Variable Rate Technology (VRT)

The term "variable-rate technology"(VRT) refers to agricultural field equipment that can accurately regulate the rate at which crop inputs such as tillage ,insect control, fertilizer, plant population and irrigation are applied. The foundation of variable rate irrigation (VRT) is the theory that varying sections of a field may have distinct soil types, topographies, crop characteristics, and other factors that could influence those sections crop characteristics, and other factors that could influence those sections input needs. Farmers can increase can increase productivity and efficiency while optimizing their use of resources by implementing VRT.

The 3 keys ways in which VRT is used in precision agriculture are:

- Fertilizers
- Pesticides
- Seeding

Figure 3: VRT for precision farming

Data analysis and Visualization

To glean insights and make wise judgements, agricultural data must be analyzed after it has been gathered and preserved. Numerous data analysis and visualization technologies, including spreadsheets, statistical software and specialized precision agriculture software, can be used for this. With the use of these technologies, farmers may find patterns and trends in their data and see the results in an easy-to-read and interpret visual format which helps in precision agriculture.

Future scope

Real time data on temperature, humidity, soil moisture content and nutrient levels can be obtained via IoT sensors. By analyzing this data, AI systems can give farmers insights into the condition of their crops, enabling them to take early action to maximize production. AI can forecast crop growth trends, insect infestations and disease outbreaks by fusing historical data with real-time sensor inputs. Farmers can reduce losses and increase overall output by proactively mitigating hazards.

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