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Introduction of AI and Drone System in Field of Farming

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ABSTRACT

The integration of artificial intelligence (AI) and drone systems in the field of cultivating addresses a groundbreaking way to deal with rural practices. This examination paper investigates the complex applications and ramifications of man-made intelligence and robot advancements in present day cultivating, zeroing in on their parts in upgrading efficiency, maintainability, and dynamic cycles. Through a far-reaching survey of existing writing, contextual investigations, and technological advancements the reconciliation of simulated intelligence and robot frameworks addresses a change in perspective in the horticultural business, enabling ranchers with significant experiences, upgrading asset usage, and cultivating feasible farming practices. By utilizing state of the art advancements and interdisciplinary methodologies, ranchers can upgrade efficiency, strength, and food security notwithstanding developing ecological and financial difficulties.

INTRODUCTION

A. BACKGROUND ON THE USE OF AI AND DRONE SYSTEM IN FIELD OF FARMING

India's economy has a significant dependence on the farming sector, as agriculture plays a crucial role in the country's socio-economic fabric. In India, the agricultural sector employs the greatest number of people and sustains the lives of a significant proportion of the populace, particularly in rural regions. A significant percentage of India's workforce is engaged in farming-related activities. Although other industries have grown more rapidly in recent years, agriculture's share of India's Gross Domestic Product (GDP) has decreased, but it still plays a significant role. Agriculture contributes to a significant portion of India's GDP, directly and indirectly. The farming sector ensures food security for the nation by producing various crops and food grains. India's agriculture sector produces a wide variety of crops, including sugarcane, wheat, vegetables, pulses, rice, and fruits. Despite its importance, the farming sector in India faces numerous challenges, including fragmented landholdings, dependence on monsoons, inadequate infrastructure, lack of modern technology adoption, and low productivity. Efforts are being made by the government and various organizations to address these challenges and improve the efficiency and sustainability of the agricultural sector through policies, subsidies, technological interventions, and infrastructure development.

The integration of AI and drone systems in farming offers various advantages, such as improved crop monitoring and management, data-driven decision-making, precision agriculture practices, and environmental stewardship. Drones and artificial intelligence (AI) in agriculture are predicted to play an increasingly larger role as technology develops, fostering sustainability and innovation in the farming sector. AI and drone systems are increasingly integrated into farming methods, providing creative answers to improve agriculture's sustainability, efficiency, and productivity.

B. AI AND DRONES ARE REVOLUTIONIZING FARMING:

- **Crop Monitoring and Management:** High-resolution photos and data of fields are captured by drones fitted with cameras and sensors, giving farmers important information about crop health, growth patterns, and possible problems like pests, illnesses, and nutrient shortages. AI algorithms analyse this data to generate actionable recommendations for precise interventions, such as targeted spraying or irrigation, minimizing input usage and maximizing yields.

- **Precision Agriculture:** Drones equipped with GPS and advanced imaging technologies enable farmers to practice precision agriculture by mapping fields, identifying variations in soil composition, moisture levels, and crop health. AI algorithms process this data to create detailed field maps and prescription maps, guiding farmers in optimizing seed planting, fertilizer application, and irrigation throughout several zones in a field.

- **Crop Scouting and Surveillance:** Drones can quickly and efficiently survey large agricultural areas, enabling farmers to monitor crops and identify potential problems in real-time. AI-powered image analysis tools help detect anomalies, such as areas of pest infestation or weed growth, enabling farmers to safeguard agricultural yields and reduce risks by acting promptly.

- **Aerial Spraying and Seeding:** Drones equipped with spraying systems or seed dispersal mechanisms can autonomously apply fertilizers, pesticides, herbicides, or plant seeds across fields with precision and accuracy. AI algorithms optimize flight paths and application rates based on field conditions and crop requirements, reducing chemical usage, minimizing environmental impact, and improving resource efficiency.

- **Data-Driven Decision Making:** The combination of AI and drone technology enables farmers to collect, analyse, and interpret vast amounts of data about their crops and fields. By leveraging AI-driven analytics platforms, regarding crop management techniques, farmers can make knowledgeable selections. resource allocation, and investment strategies, ultimately optimizing yields, reducing costs, and increasing profitability.

- **Environmental Monitoring and Conservation**: Drones equipped with specialized sensors can assess environmental parameters such as soil erosion, water quality, and vegetation cover, facilitating environmental monitoring and conservation efforts on farmland. AI algorithms process this data to identify areas at risk of degradation or areas suitable for conservation measures, supporting sustainable land management practices.

- **Livestock Management:** Drones with thermal imaging cameras installed are able to assist in monitoring livestock health and behaviour, detecting signs of illness or distress, and ensuring the welfare of animals on farms. AI-powered analytics enable farmers to analyse thermal pictures and quickly detect possible health problems, allowing for prompt intervention and lowering the chance of disease epidemics.

C. KEY AREAS WHERE DRONE IS MAKING SIGNIFICANT CONTRIBUTIONS TO FARMING

Drones are making significant contributions to farming across various key areas, revolutionizing traditional agricultural practices, and offering new opportunities for improved efficiency, productivity, and sustainability. Here are some of the primary areas where drones are making crucial contributions to farming:

- **Crop Monitoring and Assessment:** Crops can be photographed in high resolution by drones that are fitted with cameras and sensors. Using this imaging, one may keep an eye on crop health, spot stress spots, and evaluate the general growth of the plants. Farmers can use this information to make well-informed decisions about pest management, fertilization, and irrigation.

- **Precision Agriculture:** By gathering information on soil variability, moisture content, and nutrient content, drones make precision agriculture possible. With the aid of this data, farmers are able to produce intricate maps of their fields that facilitate the efficient and targeted use of resources like pesticides, fertilizer, and water. Precision farming increases productivity while lowering waste.

- **Crop Health Monitoring:** Multispectral and thermal cameras mounted on drones can detect early signs of pests, diseases, or nutrient deficiencies in crops. This initial detection allows farmers to take timely corrective actions, minimizing the impact on yields and reducing the necessity of chemical applications with a broad spectrum.

- **Aerial Seeding and Planting:** Drones can be equipped with seed dispensers to perform aerial seeding and planting. This is particularly useful for reforestation efforts, cover cropping, or planting in hard-to-reach areas. It offers a faster and more cost-effective alternative to traditional planting methods.

- **Livestock Monitoring:** Drones are employed to monitor livestock by providing aerial views of pastures and herds. This helps farmers check for the well-being of animals, assess grazing patterns, and identify potential issues. It can also aid in locating missing or injured animals in large areas.

- **Water Management:** Drones equipped with thermal sensors can identify variations in soil moisture levels across fields. This information assists farmers in optimizing irrigation practices, preventing overwatering or underwatering, and conserving water resources.

- **Surveying and Mapping:** Drones generate detailed 3D maps and topographic models of farms. These maps assist in land surveying, crop yield estimation, and the planning of infrastructure development. Farmers can learn new things into the topography of their fields, helping with drainage and contour planning.

- **Weather and Disaster Response:** Real-time meteorological data can be gathered using drones fitted with weather sensors. In the event of natural disasters such as floods or wildfires, drones can be deployed to assess the extent of the damage, plan response efforts, and prioritize areas for intervention.

- **Crop Scouting:** Drones provide a quick and efficient way to scout large areas of farmland. Farmers can

assess the overall condition of their crops, identify problem areas, and make decisions based on current knowledge without the need for time-consuming manual inspections.

- **Insurance and Documentation:** Drones are used for insurance purposes by capturing detailed aerial images of fields. This documentation is valuable for assessing crop conditions before and after adverse events, facilitating the claims process.

D. **DRONE SYSTEM AND TRADITIONAL FARMING DIFFERENCES:**

Drone systems in agriculture represent a departure from many aspects of traditional farming methods. Here are some key differences between drone-assisted farming and traditional farming practices:

• Traditional farming typically involves uniform application of inputs such as pesticides, fertilizers, and water across entire fields.

• Drone systems enable precision agriculture by allowing farmers to target inputs based on specific crop needs and field conditions. By analysing data collected by drones, farmers can create prescription maps for precise application of inputs, optimizing resource use, reducing waste, and maximizing crop yields

• Traditional farming often relies on manual observation and experience to assess crop health, soil conditions, and pest infestations.

• Drone systems gather data through aerial imagery, multispectral cameras, and sensors, giving farmers thorough information on the health of their crops, their nutritional levels, and the presence of pests. This data can be analyzed using software to generate maps, identify problem areas, and make informed decisions about resource allocation and management practices.

• Under traditional farming, monitoring crop health and growth involves walking through fields, visually inspecting plants, and manually recording observations.

• Drone systems provide farmers with a bird's-eye view of their fields, allowing for efficient and comprehensive monitoring of crop health, growth patterns, and stress indicators. This enables early detection of issues such as nutrient deficiencies, disease outbreaks, and pest infestations, facilitating timely interventions to mitigate crop losses and optimize productivity.

• Traditional farming methods can be labour-intensive and time-consuming, requiring significant manual effort for tasks such as scouting, mapping, and data collection.

• Drone systems streamline many aspects of farming operations, allowing farmers to cover large areas quickly and efficiently. Drones can perform tasks such as aerial surveys, mapping, and crop investigation in a fraction of the time that traditional methods demand, freeing up farmers' time for other important activities.

• Traditional farming practices may involve the overuse of inputs such as fertilizers and pesticides, leading to environmental pollution, soil degradation, and water contamination.

• Drone-assisted farming promotes more sustainable and environmentally friendly practices by enabling targeted application of inputs based on precise crop requirements. By minimizing chemical usage and reducing runoff, drone systems help mitigate environmental impact and promote ecosystem health and resilience.

• While the initial investment in drone technology and equipment may be important, the long-term cost savings and benefits can outweigh the expenses associated with traditional farming methods.

• Drone systems offer farmers a cost-effective solution for precision agriculture, allowing for more efficient use of resources, reduced input costs, and increased profitability over time.

E. THE IMPACT OF ARTIFICIAL INTELLIGENCE ON AGRICULTURE IN INDIA.

The World Economic Forum's Artificial Intelligence for Agriculture Innovation (AI4AI) program is addressing these issues by promoting the application of artificial intelligence (AI) and related technologies for agricultural developments, hence aiding India's agricultural revolution. This program, spearheaded by the Centre for the Fourth Industrial Revolution (C4IR) India, unites government, academic, and commercial officials to devise and execute inventive solutions for the agriculture industry.

The 'Saagu Baagu' pilot, which was designed in collaboration with the Telangana state government and is being implemented by Digital Green in the Khammam district, is among the most successful implementations of the AI4AI initiative. It has received support from the Bill and Melinda Gates Foundation. For over 7,000 farmers, the project has significantly enhanced the value chain for chilies. Through the development of supportive policies and infrastructure, such as the first agriculture data exchange and agridata management framework in India, the Telangana state government has been instrumental in this transition.

Saagu Baagu has shown impressive outcomes during its initial period of operation. A 21% increase in chili yields per acre, a 9% decrease in pesticide use, a 5% decrease in fertilizer use, and an 8% increase in unit prices as a result of quality improvements were observed by farmers involved in the program. Farmers' revenues have increased by more than INR 66,000 (about 800 USD) per acre per crop cycle as a result of these changes, nearly

doubling their income. These numbers demonstrate Saagu Baagu's efficacy as well as its contribution to productive and sustainable farming methods.

Building on these achievements, the Telangana government broadened the scope of Saagu Baagu in October 2023. Presently, the project intends to affect 500,000 farmers in ten districts, covering five distinct crops. This expansion is a calculated effort to optimize the advantages of cutting-edge agricultural technologies, which might completely change the region's agricultural environment.

F. ARTIFICIAL INTELLIGENCE REVOLUTIONISING AGRICULTURE

Globally, the topic of agricultural automation is becoming more and more popular. Artificial intelligence (AI) has found extensive direct use in agriculture recently. AI-powered solutions will not only help farmers accomplish more with less, but they will also enhance crop quality and expedite the time commodities reach the market.

The creation and application of remote sensing technologies for the identification and control of plants, weeds, pests, and diseases is made possible by developments in computer vision, mechatronics, artificial intelligence, and machine learning. Additionally, this offers a rare chance to create clever planting techniques for targeted fertilization. Farmers can use artificial intelligence solutions to assure speedier market access for their produce, increase quality, and reduce wastage.

The ability of cognitive computing to learn from, comprehend, and interact with many contexts in order to enhance output has made it the most disruptive technology in the agricultural services sector. Microsoft is currently providing agricultural, land, and fertilizer consultancy services to 175 farmers in Andhra Pradesh. Last year, this approach already produced an average yield per hectare that was 30% higher.

In order to integrate intelligent data related to past meteorology, soil reports, current research, rainfall, insect infections, and more, proximity sensing, remote sensing, the Internet of Things (IoT), and image-based precision farming are used. Drone imagery is also utilized for thorough field analysis, crop monitoring, and field surveys.

Three kinds of artificial intelligence are used in agriculture: animal farming, soil and crop management, and robots. Its aim is to make farming easier, more accurate, profitable, and productive for farmers. It is estimated that the worldwide AI market for agriculture would reach US$ 1.1 billion by 2025, from US$ 240 million in 2017. Furthermore, new strategies for boosting crop productivity are required due to issues like population growth, climate change, and food security. Understanding AI's use in agriculture is so crucial. The world will need to produce 50% more food by 2050. Unfortunately, only 4% of the additional land will be used for production in order to achieve this target. AI has the potential to spark an agricultural revolution at a time when the world needs to produce more food with fewer resources. Farmers can benefit from enhanced profitability and revenue at different stages of the agricultural process by implementing essential artificial intelligence.

AI in Indian agriculture has the ability to increase farm output, remove constraints on the supply chain, and open up new markets. The whole value chain of agriculture might profit from it. Global agriculture is predicted to benefit $4 billion from AI by 2026.

G. FARMERS IN INDIA ARE USING AI FOR AGRICULTURE

Krishna is a smallholder farmer in Telangana, India, who works his half-hectare plot with diligence every day. He makes $120 a month for this, which is just enough to cover his family's essential expenses. However, Krishna also has to deal with decreasing harvests, recurrent droughts, pest infestations, and unreliable monsoons. He has to combat the effects of shifting climatic patterns and the condition of the land. Krishna is compelled to pay exorbitant interest rates to local loan sharks for financing since he lacks access to a bank. Even still, the necessary supplies he purchases with this money—such as insecticides, fertilizers, and seeds—aren't always readily available.

Post-harvest, Krishna faces another hurdle: 40% wastage in additional supply chain links. For many farmers like Krishna, logistics, storing, and finding a market to sell their produce at pose serious obstacles. Strict quality standards that processors and dealers set are also exceedingly challenging to fulfill. Due to their limited ability to invest in the following crop cycle as a result of low earnings, these farmers become entrenched in a cycle of subsistence farming. For most farmers like Krishna, new technology that simplify their work—including drones, digital market access, and precision farming, for example—remain unattainable. They lack the resources to fully implement the technology, have restricted access to it, and may not have the time to modify their procedures.

Farmers like Krishna sometimes lose out when prices decline or demand declines, which makes the dynamics of market supply and fluctuating pricing even more difficult. Krishna must overcome these enormous obstacles, along with the other 125 million smallholder farmers in India, in order to provide for his family. These farmers view farming as a high-stakes game of chance with significant dangers and little reward. Numerous farmers in India have taken their own lives, a sign of their financial despair and the impact of weather-related issues on these individuals. Furthermore, Krishna's tale is not exclusive to India.

Almost 2 billion people are supported by an estimated 500 million smallholder farms in developing nations, which also provide about 80% of the food consumed in Asia and sub-Saharan Africa. It will need an all-encompassing, scalable strategy that incorporates financial inclusion and climatic resilience to address the predicament of Krishna and his counterparts globally and build a more sustainable and just future for smallholding farmers.

H. CONCLUSION

The integration of AI and drone technology in India offers transformative benefits across various sectors, ranging from improved agricultural practices and healthcare delivery to enhanced infrastructure management, disaster preparedness, and security measures. Embracing these technologies can contribute to India's socio-economic development, environmental sustainability, and overall progress in the digital age. However, it is essential to address regulatory, ethical, and privacy concerns while promoting innovation and ensuring equitable access to these technologies across different regions and communities in the country.

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