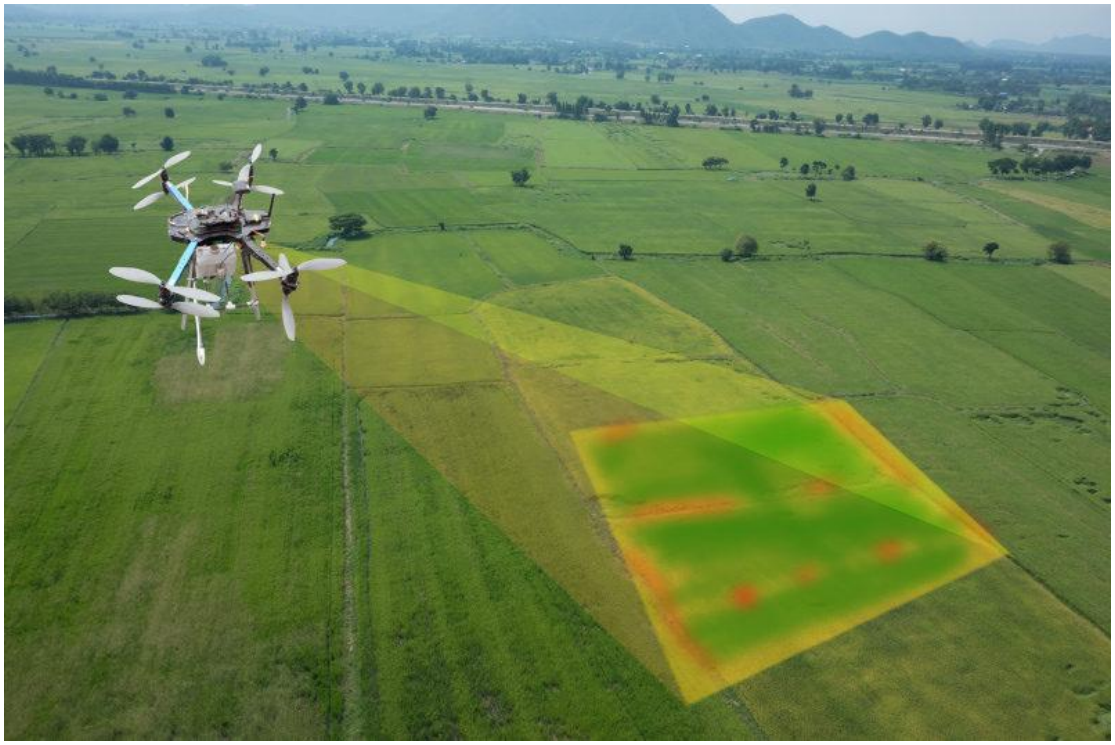

AI in Farming with help of Drone technology

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Abstract

This report examines the application of AI and drone technology in Indian agriculture, aiming to address the sector's unique challenges and opportunities. By harnessing drones equipped with AI algorithms, Indian farmers can enhance crop monitoring, optimize resource allocation, and increase yields sustainably. The abstract highlights the significance of AI-driven drone technology in overcoming constraints such as small landholdings, crop diversity, and limited access to modern farming tools. It underscores the potential of this innovation to revolutionize Indian agriculture, boost productivity, and contribute to food security and economic development in the country.

1) Problem statement

In India, traditional farming practices face challenges such as labor shortages, unpredictable weather conditions, and limited access to modern agricultural technologies. Smallholder farmers struggle with inefficient crop monitoring and management techniques, resulting in reduced yields and income instability.

2) Market/Customer/Business Need Assessment

Demands: seeks cost-effective solutions to improve yield, reduce labor dependency, and optimize resource utilization.
Target Audience: caters to farmers, cooperatives, and large-scale agricultural enterprises.

The Indian agricultural sector is vital to the country's economy, employing a significant portion of the population and contributing to food security. Indian farmers require affordable and scalable solutions to improve crop productivity, optimize resource usage, and mitigate risks associated with climate variability.

3) Target Specifications and Characterization

The target customers for AI-driven drone technology in Indian agriculture include smallholder farmers, cooperatives, and agribusinesses. The system should be affordable, easy to deploy, and adaptable to diverse cropping patterns, soil types, and climatic conditions prevalent in India.

Farm Size: The Drone Technology targets small to medium-sized farms.

Key Features:
Autonomous Navigation: Drones navigate independently.
Multispectral Imaging: Assess crop health using various wavelengths.
Real-time Data Transmission: Provide instant insights to farmers.

4) External Search(sources/references)

References:

- GitHub - AlexJinlei/Autonomous_UAVs_Swarm_Mission
- Cultivating Innovation in Agribusiness: Drafting AI Patents—Part 2 | Bennett Jones
- researchgate.net/publication/369750162_Artificial_Intelligence_in_Agriculture
- Crop yield prediction using machine learning: A systematic literature review - ScienceDirect
- DeepCrop: Deep learning-based crop disease prediction with web application - ScienceDirect
- Crop Yield Prediction Using Machine Learning - Javatpoint

External sources such as academic research papers, industry reports, government publications, and patent databases were consulted to gather insights on AI

applications in agriculture, drone technology, and regulatory frameworks relevant to India.

5) Bench marking alternate products

The documentation benchmarks AI-enabled drone solutions available in the Indian market against criteria such as cost-effectiveness, scalability, technical capabilities, and compatibility with Indian farming practices to identify gaps and opportunities for innovation.

Several leading drone companies and startups in India are providing solutions tailored for the agriculture sector:

-Aarav Unmanned Systems: Based in Bangalore, this company offers end-to-end drone solutions for precision agriculture, including crop health monitoring, soil mapping, irrigation management, and pest detection.

-Skylark Drones: Another Bangalore-based company, Skylark Drones provides drone-based data analytics across various sectors, including agriculture. They capture high-resolution images and data, offering actionable insights to farmers and agribusinesses.

-SenseHawk: With offices in California, Bangalore, and Mumbai, SenseHawk offers a cloud-based platform for drone data management and analysis. Their solutions leverage artificial intelligence and machine learning, benefiting industries such as agriculture, solar, construction, and mining.

> Swarm Drones for Monitoring Agriculture Fields:

A proposed framework involves swarm drones (unmanned aerial vehicles or UAVs) equipped with IoT applications for monitoring vast agricultural fields.
These drones collect data from cultivated areas accurately and rapidly, aiding farmers in pest control and timely fertilizer distribution.

- Agribot UAV:
The Agribot, India's first DGCA Type Certified Agriculture Drone, serves multiple purposes in agriculture.
Key features include precise spraying of pesticides and fungicides, broadcasting seeds, granules, and fertilizers, and comprehensive crop health analysis using a multispectral sensor.

6) **Applicable Patents**

For an AI invention to be patentable, it must not only be new but also represent a non-obvious advancement over existing technologies. This criterion is critical when considering the application of machine learning models in agriculture, where the novelty often lies in the application rather than the technology itself.

Investigation: Explore patents related to drone swarm technology, sensor integration, and data analysis application.

7) **Applicable Regulations**

Compliance: Adhere to Indian aviation regulations (DGCA) and environmental guidelines.
Privacy Considerations: Address data privacy concerns related to collection and usage.

Regulations governing drone operations, airspace management, data privacy, and environmental protection in India were reviewed to ensure compliance and mitigate legal risks associated with deploying AI-enabled drones in agriculture.

8) **Applicable Constraints**

Constraints such as budget limitations, infrastructure challenges, regulatory compliance, and the need for localized expertise in AI, drone technology, and agriculture were considered during the planning and development stages.
Budget: Limited funds for R&D and production.
Space: Consider storage and deployment limitations.
Expertise: Skilled personnel needed for operation and maintenance.

9) **Business Model**

The proposed business model involves offering AI-enabled drone solutions as a service (SaaS) subscription or pay-per-use model, with pricing based on factors such as farm size, crop type, data analytics capabilities, and value-added services such as -

Subscription Service: Offer subscription-based access to AI controlled Drone for farmers.

Licensing Technology: License AI controlled Drone technology to agricultural companies.
Maintenance Contracts: Provide ongoing support and software updates.
Concept Generation (Process of Coming up with Idea):
Brainstorming: Collaborate across disciplines, gather user feedback.
Iterative Refinement: Continuously improve drone swarm concepts.

10) Concept Generation

Current Status of Drone Technology in Agriculture in India:

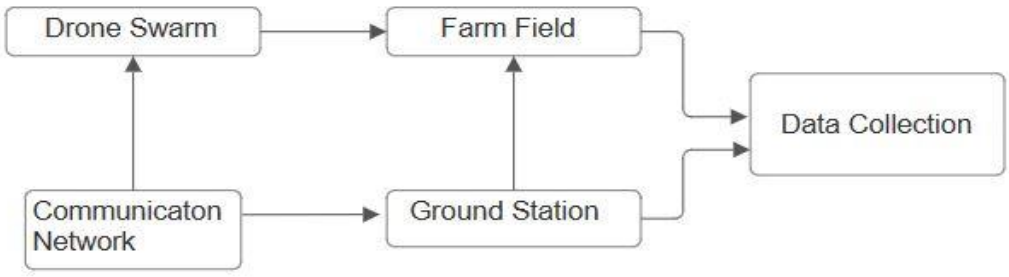
- The Indian government actively promotes the use of drones in agriculture, backed by policies like the National Drone Policy and the Drone Rules 2021.
- The Kisan Drone Scheme offers financial assistance to institutions, individual farmers, and entrepreneurs to procure and utilize drones for agricultural purposes.
- According to a report by FICCI-EY, the drone industry can significantly enhance India's manufacturing potential to approximately $50 billion by 2030, creating over 500,000 direct and indirect jobs.
- The drone market size in India is estimated to reach $885.7 million by 2021, with agriculture being one of the major sectors driving the demand.

Concept generation involved stakeholder consultations, market research, and field visits to identify key requirements, challenges, and opportunities for AI-driven drone technology in Indian agriculture.
So what is needed? It consists of multiple drones working in coordination, Features include crop monitoring, pest detection, and yield prediction.

11) Concept Development

The developed product/service is an AI-enabled drone solution tailored to Indian farming conditions, offering features such as crop monitoring, pest detection, irrigation management, and yield optimization. Further we could -
Brainstorming: Collaborate across disciplines, gather user feedback.
Iterative Refinement: Continuously improve drone swarm concepts.
AI can monitor the state of plants to spot and even predict diseases, identify and remove weeds, and recommend effective treatment of pests.

12) Final Product Prototype



The final product prototype is a fleet of AI-enabled drones equipped with sensors, cameras, and AI algorithms for real-time data collection, analysis, and decision-making. A schematic diagram illustrates the system architecture and communication flow.

13) Product Details

The product/service details include working principles, data sources (e.g., satellite imagery, weather data), algorithms (e.g., machine learning models for image analysis), frameworks, software requirements, development team composition, estimated costs, and implementation timeline. During the execution of various field operations, artificial intelligence employs a variety of sensors, including visible light sensors, broad band color-infrared sensors, thermal sensors, LiDAR sensors, multi spectral sensors, and hyper spectral sensors, as well as image processing software such as QGIS, ArcGIS, Pix4D, ERDAS, MATLAB, Adobe Photoshop, Agisoft Photoscan and others.

Drone Features:
Multispectral cameras, LiDAR, GPS.
Data Sources: Imagery, weather data, soil sensors.
Algorithms: NDVI calculation, anomaly detection.
Frameworks: ROS (Robot Operating System).
Software: Mission planning, data analytics.

The following python packages will be used for flight control, mission planning, and object detection: ppenCV 3.1, openssh-server, openssh-client, numpy, matplotlib, dronekit, pymavlink, mavproxy, netifaces, geopy.

14) Code Implementation/ Validation on small dataset

Code implementation involves developing and testing AI algorithms on a small dataset collected from Indian agricultural fields to validate performance metrics such as accuracy, precision, and scalability.

Algorithm Development: Create and validate crop health assessment algorithms.

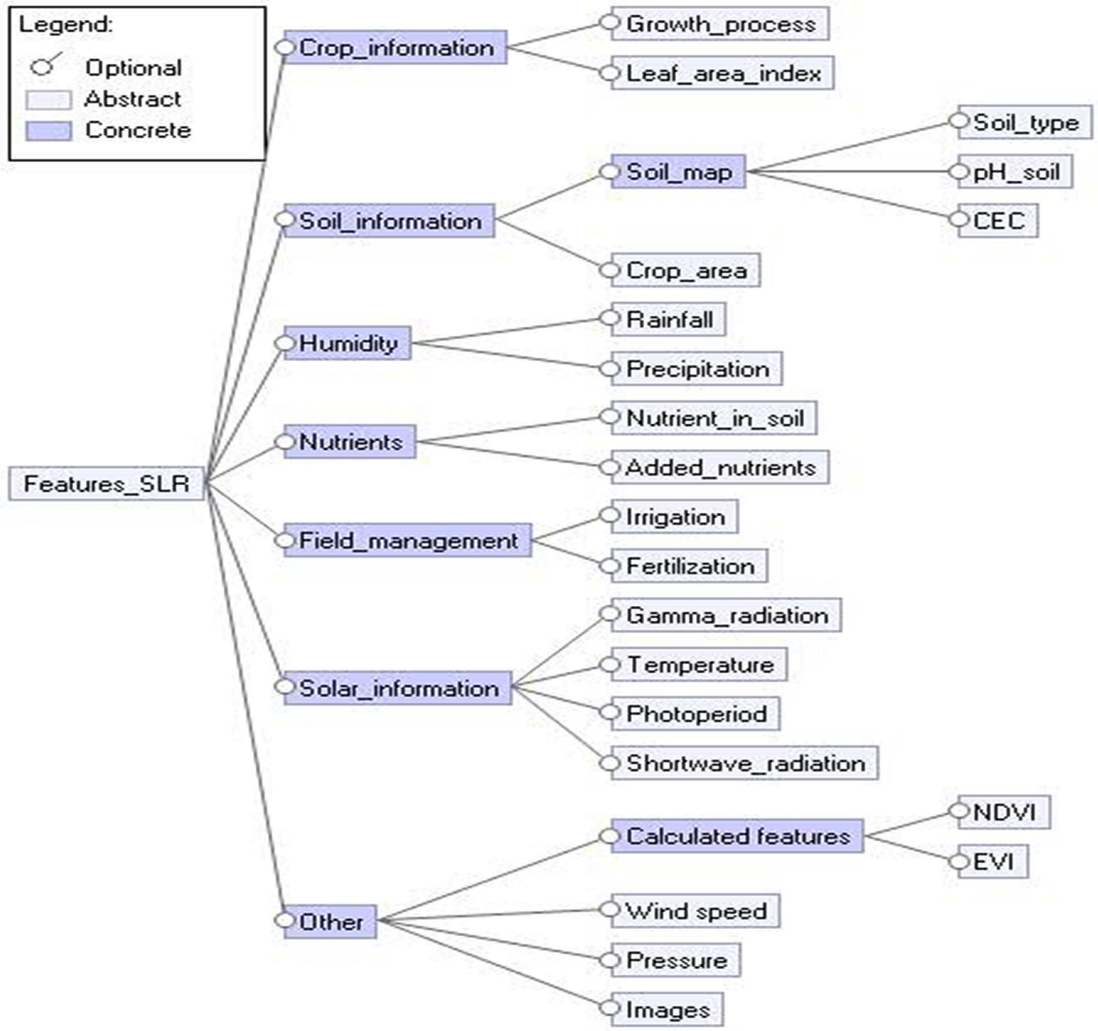
Swarm Simulation: Simulate drone behavior and communication.

Sample Crop yield dataset:

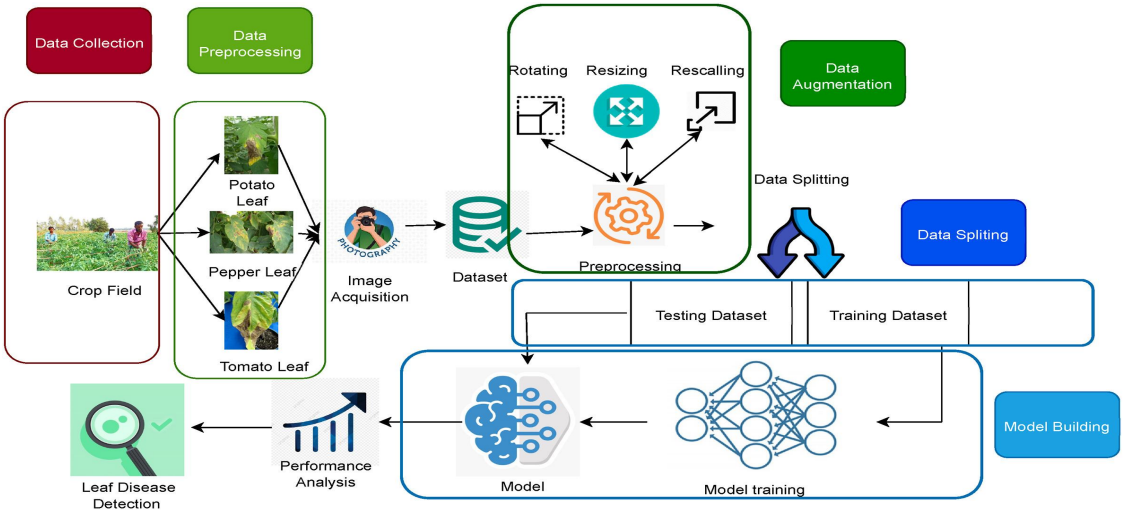
	Domain Code	Domain	Area Code	Area	Element Code	Element	Item Code	Item	Year Code	Year	Unit	Value
56707	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2007	2007	hg/ha	29998
56708	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2008	2008	hg/ha	30097
56709	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2009	2009	hg/ha	30000
56710	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2010	2010	hg/ha	27681
56711	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2011	2011	hg/ha	26274
56712	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2012	2012	hg/ha	24420
56713	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2013	2013	hg/ha	22888
56714	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2014	2014	hg/ha	21357
56715	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2015	2015	hg/ha	19826
56716	QC	Crops	181	Zimbabwe	5419	Yield	15	Wheat	2016	2016	hg/ha	18294

ML models Used: Linear regression, Decision tree, Random Forest, Ann etc

Crop yield feature Diagram:



-Another Example Of ML based Plant Disease Detection:



AI-enabled leaf disease detection system

This idea creates an opportunity to quickly and accurately identify diseased leaves by integrating a deep learning model. Our research improves the accuracy of predicting diseases. This can help experts make more accurate diagnoses, which in turn can improve harvest results.

15) Conclusion

In conclusion, the deployment of AI-driven drone technology in Indian agriculture offers significant opportunities to improve productivity, sustainability, and resilience. By addressing key challenges and leveraging technological innovations, such as AI-enabled drones, India can transform its agricultural sector and achieve food security and economic prosperity.