International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 10 | Oct - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

Review of Drone Based Crop Monitoring System

Sarthak K. Kolte
Department of E&TC
JSPM's BSP
Wagholi, Pune, India
Koltesarthak1@gmail.com

Siddhi D. Karad
Department of E&TC JSPM's BSP
Wagholi, Pune, India
Karadsiddhi95@gmail.com

Poonam V. Kamble
Department of E&TC
JSPM's BSP
Wagholi, Pune, India
kambalep524@gmail.com

Satyajit S. Keswad Department of E&TC JSPM's BSP
Wagholi, Pune, India
satyajitkeswad50@gmail.com

Mahesh N. Waghmode
Department of E&TC JSPM's BSP
Wagholi, Pune, India
mnwaghmode_entc@jspmbspoly.edu.in

Abstract— Drone-Based Crop Monitoring System is an Artificial Intelligence (AI) and Unmanned Aerial Vehicle (UAV)-based agricultural monitoring system designed to improve crop health assessment, field surveillance, and farming efficiency. The proposed system uses a drone equipped with a high-resolution camera, GPS module, and optional environmental sensors to monitor agricultural fields and collect real-time crop information. The captured images and sensor data are processed using image processing and AI-based techniques to identify crop diseases, pest infestations, nutrient deficiencies, water stress, and variations in crop growth. GPS technology helps determine the location of affected areas, enabling farmers to take timely corrective actions. The collected data can be transmitted wirelessly to a computer or mobile application for visualization, analysis, and monitoring. The system helps reduce manual field inspections, save time, optimize the use of water and fertilizers, and support early detection of crop-related problems. The proposed system provides an efficient and scalable approach to precision agriculture, smart farming, resource management, and sustainable agricultural development.

Keywords— Artificial Intelligence, Unmanned Aerial Vehicle (UAV), Drone-Based Crop Monitoring, Precision Agriculture, Image Processing, GPS, Crop Health Detection, Smart Farming.

1. Introduction

Agriculture is one of the most important sectors in India and plays a vital role in the country's economic development. Traditional methods of crop monitoring require farmers to regularly visit agricultural fields to observe crop growth, detect diseases, identify pest attacks, and monitor water requirements. These methods are time-consuming, labour-intensive, and may not provide accurate information about the condition of large agricultural fields.

A Drone-Based Crop Monitoring System is a modern agricultural technology that uses unmanned aerial vehicles (UAVs), cameras, sensors, and image-processing techniques to monitor crop health and field conditions. The drone flies over agricultural land and captures images and videos of crops from different heights and angles. The collected data is analysed to identify problems such as unhealthy crops, pest infestations, water stress, nutrient deficiencies.

The proposed system can use GPS technology for location tracking and a camera for collecting real-time crop images. Advanced image-processing techniques and Artificial Intelligence (AI) can be used to analyse the captured images and identify potential crop-related problems. The monitoring results can then be provided to farmers through a computer or mobile application, helping them make informed decisions about irrigation, fertiliser application, and pest control. This technology helps reduce manual effort, save time, optimise the use of water and fertilisers, and improve agricultural productivity. It also enables farmers to monitor large areas of land efficiently and identify crop problems at an early stage.

Therefore, the Drone-Based Crop Monitoring System provides an efficient and technology-driven approach to precision agriculture.By integrating drone technology, GPS, cameras, sensors, and intelligent image analysis, the system can support smart farming practices, reduce crop losses, and contribute to sustainable agricultural development.

2. PROPOSED SYSTEM AND ARCHITECTURE

2.1 Proposed System

The proposed Drone-Based Crop Monitoring System is designed to monitor agricultural fields efficiently using drone technology, camera-based imaging, GPS, and image-processing techniques. The main objective of this system is to help farmers observe crop conditions, identify potential agricultural problems, and make timely decisions to improve crop productivity.

In the proposed system, a drone equipped with a high-resolution camera and GPS module flies over the agricultural field and captures images and videos of crops. The GPS module records the geographical location of the monitored area, allowing farmers to identify specific locations where crop-related problems may occur. The collected images are transferred to a computer or mobile device for processing and analysis.

The captured images are analysed using image-processing techniques to examine crop appearance and identify visible symptoms of unhealthy plants, pest damage, disease, and irregular crop growth. In an advanced implementation, Artificial Intelligence (AI) and Machine Learning (ML) algorithms can be incorporated to classify crop conditions automatically. The system can also be integrated with additional sensors to collect environmental information, such as temperature, humidity, and soil moisture, depending on the requirements of the project.

After analysing the collected data, the system generates monitoring results that help farmers understand the condition of their crops. These results can be displayed through a computer or mobile application, along with location information and alerts for areas that require further inspection.
Farmers can use this information to plan irrigation, apply fertilisers appropriately, and take suitable measures to control pests and diseases.

The proposed system offers several advantages over traditional crop monitoring methods. It reduces the time and effort required for field inspection, supports the monitoring of large agricultural areas, and helps identify potential crop problems at an early stage. It also supports precision agriculture by providing location-specific information that can help farmers use agricultural resources more efficiently. The major objectives of the proposed system are:

1. To monitor crop health using drone-based aerial imaging.
2. To capture crop images and videos from different locations.
3. To identify potential crop diseases, pest damage, and unhealthy plant growth.
4. To record the geographical location of monitored areas using GPS.
5. To analyse crop images using image processing and, optionally, AI techniques.
6. To provide crop monitoring information through a computer or mobile application.
7. To support efficient resource utilisation and improve agricultural productivity.

2.2 System Architecture

The architecture of the Drone-Based Crop Monitoring System consists of several interconnected modules.
Each module performs a specific function, from aerial data collection to image analysis and the presentation of monitoring results.

1. Drone / Unmanned Aerial Vehicle (UAV): The drone acts as the main platform for aerial monitoring. It carries the camera and other required modules over the agricultural field and captures data from different areas.

2. Camera Module: The camera captures images and videos of crops. These images are used to examine plant appearance, growth patterns, and visible signs of damage. A multispectral camera may be used in advanced systems to assess vegetation characteristics.

3. GPS Module: The GPS module provides geographical coordinates associated with the monitored locations. This information helps farmers locate specific areas that may require further inspection.

5. Image Processing and AI Analysis: Image-processing software analyses the captured images to identify visible variations in crop conditions. AI-based classification can be added to detect selected diseases or other abnormalities, provided that an appropriate trained model and suitable image data are available.

6. Crop Condition Assessment: The analysed data is used to identify areas with healthy-looking crops and areas showing possible signs of stress, disease, pest damage, or uneven growth. Suspected problems may require physical inspection before treatment.

7. Farmer Dashboard or Mobile Application: The results are presented through a user interface. Farmers can view crop images, location information, analysis results, and alerts to understand the condition of their fields.
8. Agricultural Decision-Making: Farmers use the monitoring results to plan further field inspections, irrigation, fertiliser application, and pest-management activities. The system supports decisions but does not automatically guarantee the correct diagnosis or treatment.

2.4 Working Principle of the Proposed Architecture

1. The system operates in the following sequence:
2. The drone is prepared and flown over the selected agricultural field.
3. The camera captures aerial images of crops at planned intervals or locations.
4. GPS records the coordinates associated with the captured data.
5. The collected data is transferred to a computer or mobile application for storage and processing.
6. Image-processing software examines the images for visible crop abnormalities.
7. If AI is implemented, the trained model analyses the images and generates crop-condition predictions.
8. The system displays the monitoring results and associated field locations.
9. The farmer reviews the results and takes suitable agricultural action.

2.5 Expected Outcome

The proposed system is expected to make crop monitoring faster, more systematic, and less dependent on manual field inspection. It can help farmers identify areas that need attention, monitor changes in crop growth, and make more informed agricultural decisions. With suitable image data, analysis methods, and validation, the system can be further developed into an intelligent precision-agriculture solution.

3. HARDWARE-BASED SYSTEM

3.1 Overview

The hardware-based system of the Drone-Based Crop Monitoring System consists of electronic and mechanical components used to capture crop images, determine the geographical location of the agricultural field, and transfer the collected data for analysis. The hardware is mounted on or integrated with a drone to enable aerial monitoring of crops.

The proposed system uses a drone platform, camera module, GPS receiver, flight controller, battery, and wireless communication module. These components work together to collect agricultural data and transmit it to a computer or mobile device. Additional sensors can be incorporated to monitor environmental parameters and improve crop assessment.

3.2 Main Hardware Components

1. Drone / UAV

The drone is the main hardware platform of the system. It carries the camera and other electronic modules over the agricultural field. A quadcopter is suitable for a prototype because it can hover over specific areas and capture images from different angles.

2. Camera Module

The camera captures images and videos of crops from above. The collected images help examine crop growth, leaf colour, visible disease symptoms, and pest damage. A high-resolution or multispectral camera can be selected according to the project requirements



3. GPS Module

A GPS receiver, such as the NEO-6M, provides geographical coordinates of the drone. These coordinates help associate crop images with their approximate field locations. For more accurate mapping, a suitable higher-precision GNSS receiver may be required.



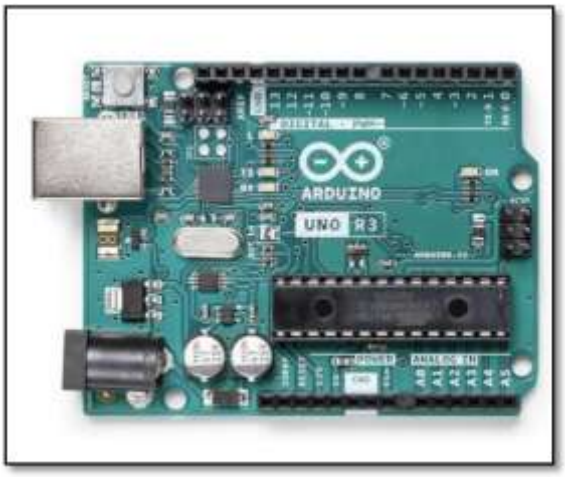
4. Flight Controller

The flight controller manages the drone's flight, motor control, and stabilisation. A controller such as Pixhawk can be used for waypoint-based flight and autonomous missions when configured with compatible GPS and other required sensors.



5. Microcontroller / Processing Unit

An Arduino or ESP32 can collect data from compatible sensors and perform basic control tasks. For image processing and AI-based crop analysis, a more capable computer, such as a Raspberry Pi or a ground-based laptop, may be used. The Arduino is not required if the flight controller and processing computer already perform these functions.



6. Wireless Communication Module

A compatible telemetry radio, Wi-Fi module, or other wireless link transfers data between the drone and the ground station. The choice depends on the required range, data rate, and whether images are transmitted live or stored for later processing.



7. Battery and Power Supply

A rechargeable LiPo battery supplies power to the drone's motors and electronic systems. Suitable voltage regulators or power modules provide the

required supply to cameras and auxiliary electronics. Battery capacity affects the drone's flight time and payload capability.



8. Environmental Sensors (Optional)

Sensors such as temperature and humidity sensors can collect local environmental readings. Soil-moisture measurements generally require a sensor placed in the soil, so a drone-mounted sensor alone cannot directly measure soil moisture reliably from the air.



3.3 Hardware Working Procedure

1. Power ON: The battery supplies power to the drone and its electronic components.
2. Flight and navigation: The flight controller uses GPS and onboard sensors to maintain flight stability and guide the drone over the field.
3. Image acquisition: The camera captures images of crops during the flight.
4. Location tagging: GPS coordinates are associated with images or recorded alongside them.
5. Data transmission: Images and sensor readings are stored locally or transferred wirelessly to a ground station.
6. Data processing: A computer processes the images and, if configured, uses AI algorithms to identify possible crop abnormalities.
7. Result display: The farmer views the processed information through a computer or mobile interface

4. WORKING OF THE SYSTEM

The Drone-Based Crop Monitoring System uses drone technology, a camera, GPS, and image-processing techniques to monitor crop health and field conditions. The system works through the following steps:

1. System Initialization: The drone, camera, GPS module, and flight controller are powered on and checked before operation.
2. Drone Flight: The drone flies over the agricultural field along a planned path to monitor the crops.
3. Image Acquisition: The camera captures images and videos of crops, while GPS records the geographical location of the monitored area.
4. Data Transfer: The collected images and location data are stored or transferred to a computer for further analysis.to a computer for further analysis.
5. Image Processing: Image-processing techniques and optional AI algorithms analyse the images to identify possible crop diseases, pest damage, and unhealthy plant growth.
6. Result Display: The analysed results are displayed on a computer or mobile application, helping farmers identify areas that require attention.
7. Agricultural Action: Based on the results, farmers can plan irrigation, fertiliser application, pest control, or further field inspection.

5. CONCLUSION



The Drone-Based Crop Monitoring System provides an efficient and modern approach to agricultural monitoring by integrating drone technology, cameras, GPS, and image-processing techniques. The system helps farmers monitor large agricultural fields, observe crop growth, and identify potential problems such as diseases, pest attacks, and unhealthy plant conditions at an early stage.

By reducing manual inspection and providing location-based crop information, the proposed system supports timely agricultural decision-making and more efficient utilisation of resources. The integration of Artificial Intelligence (AI) and Machine Learning (ML) can further improve crop analysis and automated problem detection.

In conclusion, the Drone-Based Crop Monitoring System has the potential to improve agricultural productivity, reduce crop losses, save time, and promote precision agriculture. It represents a valuable step towards smart farming and sustainable agricultur development.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to JSPM's Bhivrabai Sawant Polytechnic, Wagholi, and the Department of E&TC (Electronics and Telecommunication) for providing us with the opportunity and necessary facilities to complete our project titled "Drone-Based Crop Monitoring System."

We are deeply thankful to our respected Principal and Head of Department for their valuable support, encouragement, and guidance throughout the project. We would also like to express our sincere appreciation to our project guide for providing technical guidance, helpful suggestions, and continuous motivation during the development of this project.

We extend our thanks to all the faculty members of the E&TC Department for their cooperation and for sharing their knowledge, which helped us understand the practical applications of drone technology, GPS, image processing, and crop monitoring in modern agriculture.

Finally, we express our heartfelt gratitude to our parents, friends, and team members for their continuous encouragement, cooperation, and support.

This project has enhanced our technical knowledge and practical skills and helped us understand the importance of modern technology in improving agricultural productivity and promoting smart farming.

REFERENCES

1. DJI. Agricultural Drones and Precision Agriculture Solutions. Available at: https://www.dji.com
2. Pixhawk. Pixhawk Autopilot Documentation. Available at: https://pixhawk.org
3. ArduPilot. ArduPilot Documentation: Open-Source Autopilot Software. Available at: https://ardupilot.org

4. Raspberry Pi Foundation. Raspberry Pi Documentation. Available at: https://www.raspberrypi.com/documentation/

5. OpenCV. OpenCV Documentation: Computer Vision Library. Available at: https://docs.opencv.org

6. Google. Google Earth Engine Documentation. Available at: https://developers.google.com/earth-engine

7. Food and Agriculture Organization of the United Nations. Digital Agriculture and Precision Farming. Available at: https://www.fao.org

8. Ministry of Agriculture and Farmers Welfare, Government of India. Digital Agriculture Mission. Available at: https://agriwelfare.gov.in

9. Colomina, I., and Molina, P. "Unmanned Aerial Systems for Photogrammetry and Remote Sensing: A Review." ISPRS Journal of Photogrammetry and Remote Sensing, vol. 92, 2014, pp. 79–97.

10. Zhang, C., and Kovacs, J. M. "The Application of Small Unmanned Aerial Systems for Precision Agriculture: A Review." Precision Agriculture, vol. 13, 2012, pp. 693–712.

11. Mulla, D. J. "Twenty Five Years of Remote Sensing in Precision Agriculture: Key Advances and Remaining Knowledge Gaps." Biosystems

12. Engineering, vol. 114, no. 4, 2013, pp. 358–371.
13. Lillesand, T., Kiefer, R. W., and Chipman, J. Remote Sensing and Image Interpretation. Wiley.

BIOGRAPHIES



Mahesh N. Waghmode is a Lecturer in Department Of E&TC, JSPM's BSP, Wagholi, Pune (e-mail: mnwaghmode_entc@jspmbspoly.edu.in).



Sarthak K. Kolte is with the Department Of E&TC, JSPM's BSP, Wagholi, Pune (e-mail:koltesarthak1@gmail.com)



Siddhi D. Karad is with the Department Of E&TC, JSPM's BSP, Wagholi, Pune (e-mail:Karadsiddhi95@gmail.com)



Poonam V. Kamble is with the Department Of E&TC, JSPM's BSP, Wagholi, Pune (e-mail: kambalep524@gmail.com).



Satyajit S. Keswad is with the Department Of E&TC, JSPM's BSP, Wagholi, Pune (e-mail: satyajitkeswad50@gmaicom)