International Journal of Engineering & Extended Technologies Research (IJEETR)

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802238

Drone Based Crop Health and Disease Monitering

Ms. R. Jagavi, Mr. K. Madhavan, Mr .M. Selvam, Mr. K. Seethapathi , Mr. P .Vivek

Assistant Professor, Gnanamani College of Technology, Namakkal, Tamil Nadu, India

B. Tech, Student, Department of Agricultural Engineering, Gnanamani College of Technology, Namakkal, Tamil Nadu, India

B. Tech, Student, Department of Agricultural Engineering, Gnanamani College of Technology, Namakkal, Tamil Nadu, India

B. Tech, Student, Department of Agricultural Engineering, Gnanamani College of Technology, Namakkal, Tamil Nadu, India

B. Tech, Student, Department of Agricultural Engineering, Gnanamani College of Technology, Namakkal, Tamil Nadu, India

Publication History: Received: 25.02.2026; Revised: 20.03.2026; Accepted: 25.03. 2026; Published: 28.03.2026.

ABSTRACT: The rapid advancement of precision agriculture has created opportunities to enhance crop productivity through intelligent monitoring systems. Crop diseases remain a significant challenge, often leading to substantial yield losses if not identified at an early stage. This paper presents a drone-based crop health monitoring system that integrates image processing techniques to detect plant diseases efficiently. The proposed system employs an unmanned aerial vehicle equipped with a high-resolution camera and a Raspberry Pi processing unit to capture and analyze crop images in real time. The acquired images are processed using computer vision algorithms to identify variations in color, texture, and structural patterns associated with disease symptoms. The system offers a cost-effective and scalable solution that minimizes manual intervention while improving detection accuracy. Experimental observations indicate that the proposed approach significantly reduces monitoring time and enhances decision-making for farmers. This work contributes to the development of smart agricultural practices by combining aerial surveillance with embedded image analysis.

KEYWORDS: Precision Agriculture, Drone Monitoring, Image Processing, Crop Disease Detection, Raspberry Pi, Computer Vision

I. INTRODUCTION

Agriculture continues to play a crucial role in sustaining the global population, yet it faces persistent challenges due to crop diseases and environmental stress factors. Early

detection of plant diseases is essential to prevent large-scale damage and ensure optimal yield. Conventional methods of crop monitoring rely on manual field inspection, which is labor-intensive, time-consuming, and often inaccurate when applied to large agricultural areas. The integration of modern technologies such as unmanned aerial vehicles and

embedded systems has opened new possibilities for efficient crop surveillance. This study proposes a drone-based monitoring system designed to capture high-resolution images of crops and analyze them using image processing techniques. The objective is to provide a reliable and automated method for detecting disease symptoms at an early stage, thereby supporting farmers in implementing timely and effective interventions.

II. LITERATURE REVIEW

Recent research in precision agriculture has extensively explored the use of unmanned aerial vehicles (UAVs) for crop health assessment and disease detection. Chin [1] presented a comprehensive systematic review of drone-based plant disease detection methods, highlighting the advantages of aerial platforms in achieving wide-area coverage and early identification of disease symptoms. The study also emphasized key challenges such as illumination variability,

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802238

occlusions within dense canopies, and the need for robust algorithms capable of handling field-scale heterogeneity. These findings establish the relevance of UAV platforms as an effective monitoring tool while underscoring the practical constraints faced in real-world deployments.

Multispectral imaging has been widely adopted in UAV-based agricultural monitoring due to its ability to capture physiological information related to vegetation vigor. Reddy [2] demonstrated the effectiveness of drone-based multispectral imaging for precision agriculture applications, showing strong correlation between spectral indices and crop condition. However, the requirement for specialized sensors, calibration procedures, and higher operational costs limits the scalability of multispectral solutions, particularly for small and medium-scale farmers. This motivates the exploration of low-cost alternatives that can deliver acceptable performance under practical constraints.

A broader perspective on crop attribute monitoring technologies was provided by Li [3], who reviewed sensing modalities and analytics approaches for modern agriculture. The study emphasized the trade-offs between sensing fidelity, computational complexity, and deployability. RGB imaging was identified as a cost-effective modality capable of capturing visible stress indicators such as discoloration and canopy non-uniformity, albeit with sensitivity to environmental conditions. This insight supports the feasibility of RGB-based monitoring when complemented by appropriate preprocessing and normalization strategies.

Learning-based disease detection methods using UAV-acquired RGB imagery have gained attention in recent years. The work reported in [4] integrated deep learning with UAV RGB images for automated detection of downy mildew, demonstrating improved detection performance under controlled acquisition settings. Similarly, Saravanakumar and Prabhu [5] proposed an AI-powered crop health monitoring framework combining drone image processing with machine learning techniques, achieving enhanced detection accuracy. Despite their promising performance, such approaches require substantial labeled datasets, computational resources, and careful model tuning, which may hinder real-time deployment in resource-constrained environments.

In summary, existing literature demonstrates the effectiveness of UAV platforms for crop health monitoring using multispectral sensing and learning-based analytics, while also revealing practical limitations related to cost, data requirements, and field robustness. The proposed work differentiates itself by focusing on a deployable, low-cost UAV-based framework using RGB imaging and classical image processing, emphasizing illumination-aware preprocessing, vegetation region isolation, and region-wise abnormality detection. This design choice aims to bridge the gap between research-grade solutions and practical systems suitable for routine agricultural operations.

III. RESEARCH METHODOLOGY

The proposed project presents a deployable unmanned aerial vehicle (UAV)-based framework for field-scale crop health and disease monitoring using RGB imaging and computer vision techniques. The primary objective is to provide a practical, low-cost solution that enables rapid assessment of spatial crop variability and early identification of abnormal vegetation regions. The system is designed to support routine agricultural surveillance by combining aerial data acquisition with a modular image analytics pipeline optimized for field conditions.

The overall framework consists of three principal layers: (i) aerial sensing, (ii) ground-station analytics, and (iii) visualization and decision support. The aerial sensing layer employs a UAV equipped with an RGB camera to capture nadir-view images of crop canopies along pre-planned flight paths. Mission planning is performed to ensure consistent ground sampling distance, adequate image overlap, and uniform coverage across the field, thereby improving the reliability of downstream analysis.

At the ground-station analytics layer, the acquired imagery is subjected to illumination-aware preprocessing to mitigate the effects of variable sunlight conditions and sensor noise. Vegetation regions are isolated from background elements such as soil and pathways to constrain the analysis to canopy pixels. The system then computes region-wise color and texture descriptors that capture visible manifestations of crop stress, including discoloration, patchiness, and canopy non-uniformity. A region-based abnormality analysis is performed by comparing local feature distributions against reference healthy baselines derived from representative field patches. This enables the identification of spatially localized stress-prone zones without requiring extensive labeled training data.The visualization and decision support layer generates intuitive crop health maps by projecting detected abnormal regions onto the original aerial imagery. These maps facilitate rapid situational awareness and guide targeted ground inspection and localized agronomic interventions. The modular design of the framework allows incremental enhancements, such as temporal analysis

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802238

across growth stages, integration of geo-referencing for precise localization, and coupling with variable-rate treatment mechanisms.

The proposed project emphasizes affordability, operational simplicity, and scalability. By relying on widely available RGB imaging hardware and classical computer vision methods, the system lowers the entry barrier for adopting precision agriculture technologies in resource-constrained farming environments. The framework is intended as a screening tool to prioritize regions for closer inspection, thereby optimizing labor deployment and enabling timely preventive actions to mitigate yield loss

IV. SYSTEM METHODOLOGY

The methodology of the proposed system is based on aerial image acquisition followed by on-board image analysis. The drone is deployed over the agricultural field to capture images at predefined altitudes, ensuring adequate coverage and resolution. The captured images are transmitted to the Raspberry Pi, where preprocessing techniques such as noise reduction and contrast enhancement are applied to improve image quality. The processed images are then subjected to segmentation methods to isolate regions of interest, particularly leaf surfaces. Feature extraction techniques are used to analyze variations in color distribution, texture patterns, and structural irregularities. These features are compared against predefined thresholds to identify the presence of disease symptoms. The system operates in a semi-automated manner, providing results that can be stored or displayed for further evaluation.

a. System Design and Implementation

The proposed system integrates both hardware and software components to achieve efficient performance. The hardware setup consists of a drone platform equipped with propulsion units, a power supply system, a Raspberry Pi module, and a camera sensor. The Raspberry Pi serves as the central processing unit, handling image acquisition and processing tasks. On the software side, the system is developed using Python programming language, incorporating image processing libraries such as OpenCV. The implementation process involves capturing aerial images, converting them into appropriate formats, and applying filtering, segmentation, and feature extraction techniques to detect anomalies in crop health. The system is designed to be lightweight and energy-efficient, allowing it to operate effectively within the constraints of drone-based applications. The integration of hardware and software ensures seamless data acquisition and analysis in real time.

IV. RESULTS AND DISCUSSION

The experimental results demonstrate that the proposed system is capable of detecting visible symptoms of crop diseases with satisfactory accuracy. The system successfully identifies variations in leaf color, including yellowing, spotting, and discoloration, which are indicative of potential infections. The use of aerial imaging enables rapid coverage of large agricultural areas, significantly reducing the time required for monitoring compared to traditional methods. The performance of the system is influenced by environmental factors such as lighting conditions, wind stability, and camera resolution. Despite these challenges, the system provides consistent and reliable outputs, making it suitable for practical deployment in agricultural fields. The analysis confirms that the integration of drone technology with image processing enhances the efficiency and effectiveness of crop disease monitoring.

International Journal of Engineering & Extended Technologies Research (IJEETR)

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802238

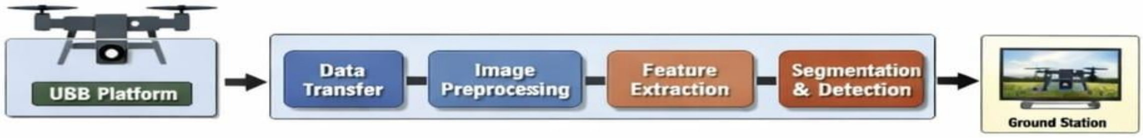

Fig. 1. Block diagram of the proposed UAV-based crop health and disease monitoring system.

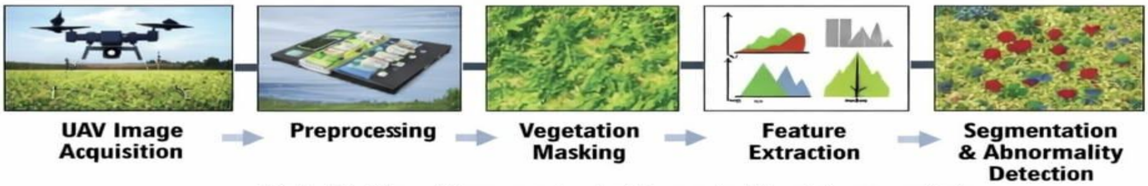

Fig. 2. Workflow of the proposed method for crop health and disease monitoring.

Fig. 3. *Sample aerial image of the crop field captured by the UAV.*

V. CONCLUSION

This paper presents a drone-based crop health monitoring system that utilizes image processing techniques for efficient disease detection. The integration of aerial imaging and embedded processing provides a modern solution to the challenges faced in traditional agricultural practices. The system reduces the need for manual inspection, improves monitoring speed, and enhances the accuracy of disease identification. The results demonstrate the feasibility and effectiveness of the proposed approach in real-world agricultural scenarios. With further enhancements and technological integration, the system has the potential to play a significant role in advancing precision agriculture and ensuring sustainable crop production

VI. FUTURE WORK

The future development of this system can focus on incorporating machine learning and deep learning algorithms to improve the accuracy and automation of disease detection. The integration of real-time communication systems can enable instant transmission of results to farmers through mobile applications. Advanced sensors, including multispectral and thermal cameras, can be used to detect diseases at an early stage before visible symptoms appear. Autonomous navigation systems can further enhance the efficiency of drone operations by enabling pre-programmed flight paths and obstacle avoidance. The system can also be expanded to include yield prediction, soil analysis, and irrigation management, contributing to a comprehensive smart farming solution. These advancements will transform the proposed system into a fully intelligent agricultural monitoring platform.

REFERENCES

1. **D. P. Hughes and M. Salathé**, "An Open Access Repository of Images on Plant Health to Enable the Development of Mobile Disease Diagnostics," arXiv preprint arXiv:1511.08060, 2015.
2. **S. P. Mohanty, D. P. Hughes, and M. Salathé**, Gnanamani "Using Deep Learning for Image-Based Plant Disease Detection," Frontiers in Plant Science, vol. 7, pp. 1–10, 2016.
3. **K. R. Aravind, P. Raja, S. Mukesh, K. Aniirudh, R. Ashiwin, and C. V. Karthik**, "Disease Classification in Maize Crop Using Bag of Features and Multiclass SVM,"

2018 IEEE International Conference on Advances in Computing, Communications and Informatics, pp. 1191–1196, 2018.

4. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor &Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
5. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of Electrical Engineering, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2
6. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
7. S.Tamilselvi, R.Prakash, C.Nagarajan,"Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering, DOI10.1007/s40998-025-00917-z,2025
8. S.Tamilselvi, R.Prakash, C.Nagarajan," Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" Electric Power Systems Research 253 (2026) 112428, doi.org/10.1016/j.epsr.2025.112428
9. S.Thirunavukkarasu, C. Nagarajan, 2024, "Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," Journal of Electrical Engineering And Technology, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
10. C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- Acta Electrotechnica et Informatica Journal , Vol.13 (2), pp.18-31,April-June.2013, DOI: 10.2478/aeei-2013-0025.
11. C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- Springer, Frontiers of Electrical and Electronic Engineering, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
12. C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.
13. C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
14. Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", Revista Materia (Rio J.) Vol. 30, 2025, DOI: https://doi.org/10.1590/1517-7076-RMAT-2024-0721
15. M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
16. **J. G. A. Barbedo**,
"Impact of Dataset Size and Variety on the Effectiveness of Deep Learning and Transfer Learning for Plant Disease Classification,"Computers and Electronics in Agriculture, vol. 153, pp. 46–53, 2018
17. **A. Kamilaris and F. X. Prenafeta-Boldú**, "Deep Learning in Agriculture: A Survey," Computers and Electronics in Agriculture, vol. 147, pp. 70–90, 2018
18. **N. Brahimi, K. Boukhalfa, and A. Moussaoui**, "Deep Learning for Tomato Diseases: Classification and SymptomsVisualization,"
Applied Artificial Intelligence, vol. 31, no. 4, pp. 299–315, 2017.
19. **Kiran, A., Rubini, P., & Kumar, S. S. (2025).** Comprehensive review of privacy, utility and fairness offered by synthetic data. *IEEE Access.*
20. **Gopinathan, V. R. (2024).** Real-Time Financial Risk Intelligence Using Secure-by-Design AI in SAP-Enabled Cloud Digital Banking. *International Journal of Computer Technology and Electronics Communication, 7(6), 9837-9845.*
21. **Udayakumar, R., Elankavi, R., Vimal, R., & Sugumar, R. (2023).** Improved Particle Swarm Optimization with Deep Learning-Based Municipal Solid Waste Management in Smart Cities. *Environmental & Social Management Journal, 17(4).*
22. **Anand, L. (2023).** An Intelligent AI and ML–Driven Cloud Security Framework for Financial Workflows and Wastewater Analytics. *International Journal of Humanities and Information Technology, 5(02), 87-94.*
23. **Soundappan, S. J. (2020).** Big Data Analytics in Healthcare: Applications for Pandemic Forecasting. *International Journal of Advanced Research in Computer Science & Technology, 3(1), 2248-2253.*

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802238

24. **Rajasekar, M. (2024).** Real-Time Predictive DevOps Intelligence for Risk-Aware Digital Business Processes in Cloud and SAP Ecosystems. *International Journal of Advanced Research in Computer Science & Technology, 7(4), 10713-10718.*
25. **Poornima, G., & Anand, L. (2024, May). Novel AI Multimodal Approach for Combating Against Pulmonary Carcinoma. In 2024 5th International Conference for Emerging Technology (INCET) (pp. 1-6). IEEE.**
26. **Prabha, P. S., & Rengarajan, A. (2025).** Adaptive Cloud Resource Allocation Using Attention-Driven Deep Reinforcement Learning. *Engineering, Technology & Applied Science Research, 15(6), 29334-29340.*
27. **Jagadeesh, S., & Sugumar, R. (2017).** A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences, 9(5), 243-248.*
28. **Varma, K. K., & Anand, L. (2025, March). Deep Learning Driven Proactive Auto Scaler for High-Quality Cloud Services. In International Conference on Computing and Communication Systems for Industrial Applications (pp. 329-338). Singapore: Springer Nature Singapore.**
29. **Kumar, S. A., & Anand, L. (2025). A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. KSII TRANSACTIONS ON INTERNET AND INFORMATION SYSTEMS, 19(11), 3841-3855.**
30. **Poornima, G., & Anand, L. (2025). Medical image fusion model using CT and MRI images based on dual scale weighted fusion based residual attention network with encoder-decoder architecture. Biomedical Signal Processing and Control, 108, 107932.**
31. **Archana, R., & Anand, L. (2025). Residual u-net with Self-Attention based deep convolutional adaptive capsule network for liver cancer segmentation and classification. Biomedical Signal Processing and Control, 105, 107665.Kumar, S. A., & Anand, L. (2025).** A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII Transactions on Internet and Information Systems, 19(11), 3841-3855.*
32. **Rengarajan, A. (2025).** Cloud-Based AI-Driven Threat Detection Framework for Smart Grid Cybersecurity. *International Journal of Future Innovative Science and Technology, 8(6), 16065.*
33. **Murugeshwari, B., Sudharson, K., Panimalar, S. P., Shanmugapriya, M., & Abinaya, M. (2020).** SAFE–Secure Authentication in Federated Environment using CEG Key code.
34. **Raj A. A., & Sugumar, R. (2023).** Early Detection of COVID-19 with Impact on Cardiovascular Complications using CNN Utilising Pre-Processed Chest X-Ray Images. *2023 International Conference on Applied Intelligence and Sustainable Computing (ICAISC), IEEE.*
35. **Jagadeesh, S., & Sugumar, R. (2017). A Comparative study on Artificial Bee Colony with modified ABC algorithm. European Journal of Applied Sciences, 9(5), 243-248.**
36. **Selvi, G. V., Anbarasan, A. B., Murthy, B. A., & Prabavathy, S. (2023).** An Application Oriented Integrated Unequal Clustering Algorithm for Wireless Sensor Network. In *Underwater Vehicle Control and Communication Systems Based on Machine Learning Techniques* (pp. 140-154). CRC Press.
37. **Sruthi, R. S., Ananya, S., & Murugeshwari, B. (2010).** Web Based Virtual Control System Laboratory and On-Line Temperature Control of Electrophoresis Equipment using LabVIEW. *International Journal of Computer Applications, 975, 8887.*
38. **Vimal Raja, G. (2021).** Mining Customer Sentiments from Financial Feedback and Reviews using Data Mining Algorithms. *International Journal of Innovative Research in Computer and Communication Engineering, 9(12), 14705-14710.*
39. MATHEW, A. R. (2025). Neurosecurity and Brain-Computer Interfaces.
40. Soundappan, S. J. (2024). AI-Driven Customer Intelligence in Enterprise Lakehouse Systems Sentiment Mining Governance-Aware Analytics and Real-Time Data Synchronization. International Journal of Advanced Engineering Science and Information Technology (IJAESIT), 7(5), 14905.
41. Mathew, A. (2025). Human–AI Collaboration in Security Operations: Measuring Alert Trust, Automation Bias, and Analyst Upskilling in AI-Augmented SOC Environments. International Journal of Computer Technology and Electronics Communication, 8(5), 11375-11380.
42. Soundappan, S. J. (2022). AI-Based Fault Detection and Isolation for Reliability in Modern Power Systems. International Journal of Research Publications in Engineering, Technology and Management (IJRPETM), 5(4), 7106-7110.