
GREEN GENIE: A COMPREHENSIVE SURVEY ON SMART FARMING, AI, AND DIGITAL AGRICULTURE

***Mayur Chavan, Harshada Avhad, Aayush More, Atharv Ingale, Varsha Bombe, Swati
Firame (Guide)**

Sinhgad Institute of Technology and Science, Pune Narhe, Pune, India.

Article Received: 5 May 2026, Article Revised: 25 May 2026, Published on: 15 June 2026

***Corresponding Author: Mayur Chavan**

Sinhgad Institute of Technology and Science, Pune Narhe, Pune, India.

Doi: <https://doi-doi.org/101555/ijarp.5908>

ABSTRACT

Agriculture is rapidly transforming through the integration of Artificial Intelligence (AI), Internet of Things (IoT), cloud computing, and mobile technologies. Traditional farming methods face major challenges such as crop diseases, water scarcity, unpredictable weather conditions, and inefficient market systems. This survey paper presents a comprehensive analysis of modern smart farming technologies and their role in improving agricultural productivity and sustainability. The study focuses on AI-based crop disease detection, IoT-enabled monitoring systems, real-time weather analysis, cloud-based agricultural services, and digital marketplaces for farmers. The paper also discusses the Green Genie platform, which aims to provide an integrated smart farming ecosystem using Flutter, Python, and Firebase technologies. The survey identifies the major research gap in current agricultural systems, namely the lack of centralized and user-friendly digital solutions for farmers. The study concludes that an integrated smart farming platform can significantly improve decision-making, reduce manual effort, and promote sustainable agricultural practices.

INDEX TERMS: Smart Farming, Artificial Intelligence, Internet of Things, Green Genie, Flutter, Firebase, Crop Disease Detection, Sustainable Agriculture, Precision Farming.

I. INTRODUCTION

Agriculture plays an important role in the economy of developing countries. However, traditional farming practices still dominate in many rural regions, leading to reduced productivity and inefficient resource management. Farmers often face difficulties such as inaccurate crop selection, lack of weather information, crop diseases, and unfair market

pricing. With the advancement of digital technologies, smart farming systems have emerged as a solution to modern agricultural problems. Technologies such as Artificial Intelligence (AI), Internet of Things (IoT), machine learning, and cloud computing provide real-time monitoring and intelligent decision-making capabilities.

Green Genie is a smart farming platform designed to integrate modern technologies into agriculture. The platform provides services such as crop disease detection, weather monitoring, crop recommendation, and digital marketplace facilities. The main objective of the system is to improve productivity, reduce manual effort, and empower farmers through intelligent agricultural solutions.

II. LITERATURE REVIEW

Recent studies in smart agriculture highlight the growing importance of digital farming technologies. Researchers have proposed multiple systems for crop monitoring, disease detection, and agricultural automation.

A. IoT-Based Smart Farming

IoT-based farming systems use sensors to monitor environmental conditions such as soil moisture, temperature, humidity, and water levels. These systems provide real-time agricultural data and support automated irrigation systems.

The general IoT farming architecture consists of:

- Sensors
- Microcontrollers
- Wireless communication
- Cloud database
- User dashboard

Although these systems improve efficiency, many existing solutions lack integration with AI-based analytics and marketplace services.

B. AI-Based Crop Disease Detection

Artificial Intelligence has significantly improved agricultural automation. Machine learning and deep learning algorithms are used to identify crop diseases using image analysis techniques.

Common AI algorithms include:

- Convolutional Neural Networks (CNN)
- Support Vector Machines (SVM)

- RandomForestAlgorithms
- DecisionTrees

AI models can predict crop diseases with high accuracy, helping farmers take preventive measures at an early stage.

C. Research Gap

The literature survey reveals that most agricultural systems focus on individual functionalities such as weather prediction or crop analysis. Very few systems provide a unified platform integrating all essential farming services. Farmers are often required to use multiple disconnected applications, which creates usability challenges.

Green Genie addresses this gap by combining multiple agricultural services into a single smart farming ecosystem.

III. PROBLEM STATEMENT

Farmers face several challenges due to fragmented agricultural systems and limited access to modern technologies. Existing solutions are often expensive, isolated, or difficult to use for small-scale farmers.

Major problems include:

- Lack of real-time agricultural information
- Difficulty in identifying crop diseases
- Water wastage due to manual irrigation
- Limited access to fair marketplaces
- Poor decision-making due to insufficient data

There is a need for a centralized and intelligent farming platform that integrates agricultural services into a single user-friendly environment.

IV. SMART FARMING TECHNOLOGIES

A. Artificial Intelligence in Agriculture

Artificial Intelligence improves agricultural productivity through predictive analysis and automation. AI models analyze crop conditions, weather data, and soil quality to generate recommendations.

The crop yield prediction model can be represented as:

$$Y=f(S,W,T,N)(1)$$

where:

- Y =CropYield
- S =SoilQuality
- W =WaterAvailability
- T =Temperature
- N =NutrientLevel

AI-based systems improve crop quality and reduce financial losses.

B. Internet of Things (IoT)

IoT devices collect agricultural data using smart sensors. These sensors monitor:

- Soil moisture
- Humidity
- Temperature
- Water level
- Soil pH

The collected data is transmitted to cloud platforms for analysis and monitoring.

C. Cloud Computing

Cloud computing enables real-time storage and processing of agricultural data. Farmers can remotely access information through mobile applications.

Cloud services provide:

- Data synchronization
- Real-time monitoring
- Backup and recovery
- Scalable storage
- Secure authentication

V. GREENGENIE SYSTEM ARCHITECTURE

The GreenGenie platform follows a three-layer architecture consisting of:

- Presentation Layer
- Business Logic Layer
- Data Layer

A. Presentation Layer

The frontend is developed using Flutter, providing a responsive and user-friendly mobile application. Different dashboards are provided for farmers, buyers, and

administrators.

B. BusinessLogicLayer

The backend is implemented using Python. The system handles:

- User authentication
- Crop disease detection
- Weather processing
- Marketplace operations
- Recommendation systems

C. DataLayer

Firebase Firestore is used for secure and scalable cloud storage. It manages:

- User information
- Crop records
- Transactions
- Weather data
- Marketplace listings

VI. EXPERIMENTATION AND ANALYSIS

The Green Genies system was tested under multiple user scenarios to evaluate performance and usability.

A. Performance Analysis

Experimental results showed:

- Login response time: approximately 1 second
- Crop disease prediction: 2–3 seconds
- Real-time database synchronization
- Smooth marketplace operations

B. Security Validation

Firebase Authentication and secure APIs were used to protect user information and prevent unauthorized access.

C. Usability Testing

Users reported that the application was:

- Easy to navigate
- Responsive across devices
- User-friendly for farmers
- Efficient for agricultural operations

VII. RESULTS AND DISCUSSION

The Green Genie platform successfully integrates multiple agricultural services into a unified smart farming system.

Major achievements include:

- Accurate crop disease detection
- Real-time weather monitoring
- Secure cloud data management
- Efficient marketplace integration
- Improved user accessibility

The system reduces dependency on disconnected applications and improves decision-making through intelligent recommendations. Analysis confirms that the platform improves accessibility, productivity, and decision-making for farmers.

Green Genie demonstrates how modern technologies can transform traditional agriculture into a more efficient, scalable, and sustainable ecosystem.

VIII. FUTURE SCOPE

Future enhancements for Green Genie include:

- IoT-based automated irrigation
- Drone-based crop monitoring
- Blockchain integration for transparency
- Advanced machine learning models
- Multi-language support

The system can evolve into a complete digital agriculture ecosystem supporting sustainable farming practices.

IX. CONCLUSION

This survey paper analyzed the role of Artificial Intelligence, IoT, cloud computing, and mobile technologies in smart farming systems. Existing agricultural systems often suffer from fragmentation and lack integration between services. Green Genie addresses this problem by providing a centralized and intelligent farming platform.

The system integrates crop disease detection, weather monitoring, marketplace operations, and cloud-based data management into a single user-friendly application. Experimental

REFERENCES

1. Akkem, Y., Biswas, S. K., and Varanasi, A., "Smart Farming Using Artificial Intelligence: A Review," *Engineering Applications of Artificial Intelligence*, 2023.
2. Nitin and Gupta, S. B., "Artificial Intelligence in Smart Agriculture: Applications and Challenges," *Current Applied Science and Technology*, vol. 24, no. 2, 2023.
3. Memon, K. et al., "Artificial Intelligence in Sustainable Smart Agriculture: Concepts, Applications and Challenges," *VAWKUM Transactions on Computer Sciences*, 2025.
4. R.N.Rao and B.Sridhar, "IoT Based Smart Crop-Field Monitoring and Automation Irrigation System," *International Conference on Inventive Systems and Control*, 2018.
5. J.Wolfert et al., "Big Data in Smart Farming—A Review," *Agricultural Systems*, vol. 153, pp. 69-80, 2017.