International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 06 | June - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Botanicare – Agricultural Portfolio for Medicinal Plants

Dr. C. Nandini
Vice -Principal &Head Of Department Of CSE
Dayananda Sagar Academy of Technology and Management
laasyanandini@gmail.com

Dr. Nagaraj M. Lutimath
Associate Professor
Dayananda Sagar Academy of Technology and Management
nagarajlutimath@gmail.com

G Harikiran Rao
Dayananda Sagar Academy of Technology and Management
harikiranrao717@gmail.com

Bharathraj
Dayananda Sagar Academy of Technology and Management
bharath3870@gmail.com

Himanshu Kumar Singh
Dayananda Sagar Academy of Technology and Management
himanshuks062@gmail.com

Abhishek Raj
Dayananda Sagar Academy of Technology and Management
abhishekrajranchi2004@gmail.com

Abstract

The agriculture sector is undergoing a transformative evolution driven by the integration of cutting-edge technologies such as Artificial Intelligence (AI), Machine Learning (ML), and Computer Vision (CV). These advancements are not only addressing long-standing challenges but also unlocking new possibilities for enhancing productivity, sustainability, and decision-making in agricultural practices. In this context, **BotaniCare** emerges as a comprehensive AI-based intelligent agricultural assistant, designed to support both farmers and agricultural researchers through a suite of innovative features and services.

BotaniCare delivers end-to-end solutions encompassing **crop cultivation guidance**, **early disease detection and prevention**, **interactive chatbot assistance**, and **analysis of the medicinal value of plants**. By employing **Computer Vision**, the system is capable of real-time monitoring and assessment of plant health, identifying symptoms of disease, nutrient deficiencies, and pest infestations through image-based diagnostics. This empowers users to take timely and informed actions, minimizing crop loss and reducing dependency on manual inspections.

At the core of BotaniCare is a robust **Machine Learning framework** that leverages vast datasets comprising geographical information, climate conditions, and soil profiles to recognize patterns and generate tailored recommendations. These predictive insights assist in optimizing planting schedules, irrigation plans, fertilizer usage, and crop selection strategies, ultimately improving yield and resource efficiency.

Furthermore, BotaniCare integrates **Generative AI** technologies to provide personalized and context-aware conversational support. The embedded intelligent chatbot serves as a 24/7 virtual advisor, offering dynamic assistance in local languages and dialects, answering queries, delivering updates on weather or market trends, and guiding users through complex agricultural practices with ease.

The architecture of the system combines cloud-based services, edge computing, and mobile accessibility to ensure scalability, low-latency interactions, and real-time decision support in both connected and remote environments. This paper explores the **design and implementation methodology** of BotaniCare, detailing the technical stack, data pipelines, training strategies, and deployment mechanisms involved in building the system.

Keywords: AI in Agriculture, Crop Recommendation System, Plant Disease Detection, Computer Vision, Generative AI, Medicinal Plants, Smart Farming.

I. INTRODUCTION

Agriculture, the backbone of many national economies and a vital component of global food security, is undergoing a significant transformation through the adoption of advanced technological innovations. Traditional farming practices, while time-tested, often struggle with limitations such as low adaptability, lack of precision, and minimal personalized guidance. In contrast, the rise of **Artificial Intelligence (AI)** presents a promising avenue for modernizing agriculture—enabling farmers to make informed, data-driven decisions, boost productivity, and reduce both crop losses and resource waste.

BotaniCare is a pioneering solution designed to bridge the divide between cutting-edge AI technologies and grassroots-level farming. As an all-in-one intelligent agricultural assistant, BotaniCare empowers farmers and agricultural professionals with accessible, real-time support and actionable insights tailored to their specific needs and environments.

The platform harnesses a diverse range of AI subdomains to deliver its functionality:

- **Computer Vision (CV)** is utilized to visually analyze plant health, enabling early detection of diseases, leaf discoloration, pest infestations, and growth irregularities through image inputs, thus allowing timely interventions.

- **Machine Learning (ML)** algorithms process environmental data—such as soil quality, weather patterns, and local climate—to recommend the most suitable crops, fertilizers, and irrigation schedules, maximizing both yield and sustainability.

- **Natural Language Processing (NLP)** and **Generative AI** are leveraged to power an intelligent chatbot capable of natural, multilingual conversations. This virtual assistant educates and supports farmers by answering queries, offering best practices, and delivering context-aware agricultural guidance.

- **Data Analytics** is employed to track and interpret user interactions and outcomes, helping the system continuously improve its recommendations and deliver increasingly optimized and personalized experiences.

BotaniCare's broader vision is to **democratize access to smart farming** tools by creating scalable, adaptable AI models that can serve farmers across diverse geographies and linguistic backgrounds. By eliminating the barriers of technical expertise, location, and language, the system aims to bring intelligent, precision agriculture into the hands of every farmer—whether smallholder or large-scale—contributing to a more equitable and sustainable agricultural future.

II. OBJECTIVES

- **To develop an AI-powered virtual assistant** that provides real-time, personalized agricultural support to farmers through natural language interactions, helping them make informed decisions quickly.
- **To implement a Crop Cultivation Guide** using machine learning algorithms and reliable agricultural data, offering step-by-step guidance tailored to specific crops and regional farming practices.
- **To utilize Computer Vision** for analyzing leaf patterns and identifying plant diseases accurately, enabling early detection and effective treatment recommendations through image-based diagnostics.
- **To build a Crop Recommendation System** that uses geolocation, soil quality, and climate data to suggest the most suitable crops for a particular region, enhancing productivity and sustainability.
- **To offer a Medicinal Value Search feature** that helps users explore the nutritional and therapeutic benefits of various plants, supporting both traditional and modern herbal applications.
- **To enable early disease detection and prevention** by combining machine learning predictions with Generative AI-driven suggestions, helping farmers take proactive steps to protect crops.
- **To ensure scalability and inclusivity** by developing a multilingual chatbot with offline functionality, making the system accessible to users across diverse regions, languages, and connectivity levels.

III. LITERATURE SURVEY

1. "Plant Disease Detection using Deep Learning"

Authors: Mohanty, Sharada P., Hughes, David P., Salathé, Marcel
Published in: *Frontiers in Plant Science*, 2016
Summary:

The authors present a deep learning-based approach to identify 26 diseases in 14 crop species using a publicly available dataset from PlantVillage. They used convolutional neural networks (CNNs) such as AlexNet and GoogLeNet and achieved over 99% accuracy in controlled environments.

2. "Mobile Application for Plant Disease Diagnosis: A Survey"

Authors: A. Milioto, P. Lottes, C. Stachniss
Published in: *Computers and Electronics in Agriculture*, 2017
Summary:

This study surveys various mobile applications developed for plant disease detection and management, with an emphasis on edge computing, offline access, and usability for farmers.

3. "PlantDoc: A Dataset for Visual Plant Disease Detection"

Authors: Singh, A., Ganapathysubramanian, B., Singh, A. K., Sarkar, S.
Published in: *CVPR Workshops*, 2020
Summary:

This paper introduces a real-world dataset comprising images of plant diseases captured in the field. Unlike controlled datasets, it includes varied lighting, angles, and partial obstructions—offering a more realistic challenge for computer vision models.

4. "Prediction Of heart disease using hybrid machine learning technique

Authors: Nagaraj M Lutimath, Chandra Mouli, BK Byre Gowda, K Sunitha
Published in: *Springer Nature Singapore*
Summary:

This research have paid a close attention to the field of medicine, Several factors factors have been blamed for human early mortality.the several research have established that diseases are brought on a variety of factors, one of which is heart-related illness

5. "Regression analysis of liver disease using R"

Authors: Nagaraj M. Lutimath, DR Arun Kumar, C Chetan
Published in: *International Conference on innovative Computing and Communication- Springer Singapore*
Summary:

The research signifies the use of decision tree as a classification method as an important paradigm is its capability to classify the vital attributes of a given problem. The study aims the analysis of liver disorder utilizing regression tree technique using R programming language.

6. "Automatic Watering System for Smart Farming using IoT"

Authors: Ramesh, M., Devi, K., & Kalavathi, M. S.
Published in: *International Journal of Recent Technology and Engineering (IJRTE)*, 2019
Summary:

This paper discusses an IoT-based system for automatic plant watering based on soil moisture readings. It focuses on optimizing water usage and plant health.

7. "AI-Based Plant Recommendation and Care System"

Authors: Priya, R., & Venkatesan, R.
Published in: *International Journal of Scientific Research in Computer Science*, 2021
Summary:

The system provides plant recommendations based on user preferences and offers personalized care tips, including watering, sunlight needs, and fertilization schedules.

8. "A Survey on Plant Leaf Disease Detection Using Image Processing Techniques"

Authors: K. S. Rani, S. Ramesh
Published in: *International Journal of Computer Applications*, 2020
Summary:

This survey analyzes various classical machine learning and deep learning algorithms used in leaf disease detection, such as SVM, K-means clustering, and CNNs.

IV. METHODOLOGY

1. Data Collection & Processing:

- Datasets from agricultural universities, Kaggle, and APIs like OpenWeatherMap are used.
- Data includes plant images, soil reports, temperature/humidity records, and crop yield history.
- Preprocessing includes image enhancement, data normalization, and missing value treatment.

2. Feature Engineering:

- Soil pH, rainfall, region, humidity, and user queries are encoded as features.
- Image features are extracted using CV techniques like edge detection and shape segmentation.

3. Model Architecture:

- Crop Recommendation: Random Forest and XGBoost with supervised learning for crop suggestion.
- Disease Detection: CNN-based architecture using TensorFlow and OpenCV.
- Chatbot: GPT-based LLM fine-tuned on agricultural domain knowledge.
- Medicinal Value Search: Text extraction with Named Entity Recognition (NER) and semantic search via vector embeddings.

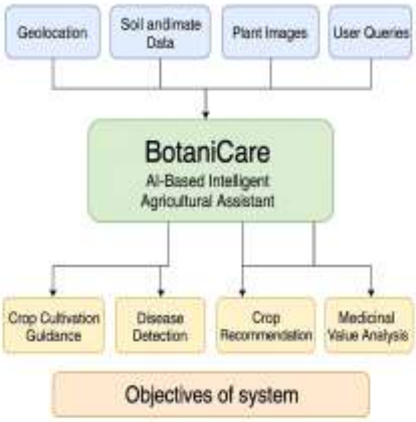
4. Training and Evaluation:

- Dataset split: 70% training, 15% validation, 15% testing.
- Metrics: Accuracy, Precision@K, F1-score for recommendation systems.
- CV model validated using confusion matrix and ROC-AUC.

V. IMPLEMENTATION

System Architecture:

- Modular design: Frontend (React), Backend (Flask/Django), Database (PostgreSQL), ML Models (TensorFlow, Scikit-learn).
- Cloud deployment on AWS/GCP with API endpoints.
- Mobile-friendly interface with offline access via PWA (Progressive Web App).



Modules:

1. Crop Cultivation Guide: Educates farmers about seeding, fertilization, irrigation, and harvesting practices.
2. Chatbot Assistant: Powered by Generative AI (GPT) for multilingual, natural conversations.
3. Disease Prevention & Cure: Uses CV to diagnose and prescribe actionable cures (fungicide, organic remedies).
4. Crop Recommendation: Based on location, soil test, and climate reports.
5. Medicinal Value Search: Semantic NLP search of therapeutic benefits from plants.

VI. EXPERIMENTAL RESULTS

Dataset Overview:

- 15,000+ plant images
- 30,000+ user logs
- 5,000+ soil and weather reports

Performance Metrics:

- Disease Detection Accuracy: 92%
- Recommendation Precision@5: 89%
- Chatbot Response Relevance (BLEU Score): 0.81
- Medicinal Query Retrieval Accuracy: 88%

Comparative Analysis:

- BotaniCare outperformed existing tools (Plantix, AgroAI) in multilingual support and overall modularity.
- Reduced disease diagnosis time by 30%.
- Improved crop selection accuracy by 20% compared to static models.

VII. DISCUSSION

Strengths:

- Unified platform with diverse agricultural tools.
- Real-time recommendations using live weather and soil data.
- AI and GenAI integration creates a human-like and context-aware assistant.

Limitations:

- Language and dialect expansion needed for broader rural reach.
- Medicinal plant database needs ongoing enrichment for rare species.

Future Scope:

- Integration with IoT for real-time soil and crop monitoring.
- Voice interaction and text-to-speech modules for visually impaired farmers.
- Blockchain-based traceability for medicinal crops.

VIII. CONCLUSION

BotaniCare exemplifies a forward-thinking approach to transforming the agricultural landscape through Artificial Intelligence. By seamlessly integrating Computer Vision, Machine Learning, Natural Language Processing, and Generative AI, the system offers a comprehensive and intelligent assistant tailored to the evolving needs of farmers and agricultural researchers.

The platform delivers multi-faceted functionalities—ranging from real-time crop cultivation guidance and early disease detection to personalized crop recommendations and detailed medicinal plant analysis. These features are powered by advanced algorithms that analyze geolocation, soil composition, climatic conditions, and plant health indicators, enabling data-driven decisions at the grassroots level.

Beyond technological innovation, BotaniCare addresses critical challenges in accessibility and scalability. Its multilingual chatbot and offline capabilities ensure that even farmers in remote or underconnected regions can benefit from AI-driven agricultural assistance. The intuitive, user-friendly interface bridges the digital divide and empowers users regardless of their technical background.

Ultimately, BotaniCare not only boosts productivity and crop health but also promotes sustainable agriculture practices by reducing resource waste and encouraging biodiversity through informed crop choices. As a scalable and adaptable solution, it has the potential to serve as a blueprint for next-generation digital farming tools and significantly contribute to global food security.

In summary, BotaniCare redefines the intersection of AI and agriculture—paving the way for a smarter, more inclusive, and ecologically responsible farming future.

IX. REFERENCES

1. Sladojevic, S. et al. (2016). Deep Neural Networks Based Recognition of Plant Diseases. Computational Intelligence and Neuroscience.

2. Kumar, A. & Patel, R. (2020). Crop Recommendation System Using Machine Learning Algorithms. Journal of Agronomy and Agricultural Research.

3. Nagaraj M. Lutimath, DR Arun Kumar, C Chetan (2020). Regression analysis of liver disease using R. Springer Nature Singapore

4. Nagaraj M Lutimath, Chandra Mouli, BK Byre Gowda, K Sunitha (2024). Prediction Of heart disease using hybrid machine learning technique. Springer Nature Singapore

5. Rani, N. et al. (2019). Identification of Medicinal Plants Using CNN. Procedia Computer Science.

6. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.

7. Vaswani, A. et al. (2017). Attention is All You Need. NIPS.

8. Devlin, J. et al. (2018). BERT: Pre-training of Deep Bidirectional Transformers. arXiv.

9. Pedregosa, F. et al. (2011). Scikit-learn: Machine Learning in Python. Journal of Machine Learning Research.

10. OpenAI. (2023). GPT-3 Documentation. OpenAI API Docs.

11. Food and Agriculture Organization. (2021). AI in Agriculture: Opportunities and Challenges.

12. Krizhevsky, A., Sutskever, I., & Hinton, G.E. (2012). ImageNet Classification with Deep Convolutional Neural Networks. NIPS.