OPEN ACCESS

Volume: 11

Special Issue: 1

Month: July

Year: 2023

E-ISSN: 2582-0397

P-ISSN: 2321-788X

Impact Factor: 3.025

Received: 08.05.2023

Accepted:13.06.2023

Published: 01.07.2023

Citation:
Kumbhar, Shreedhar Maruti, and AP Nischitha. "Crop Care Suite Using Machine Learning." *Shanlax International Journal of Arts, Science and Humanites*, vol. 11, no. S1, 2023, pp. 155–61.

DOI:
https://doi.org/10.34293/sijash.v11iS1-July.6331

Crop Care Suite Using Machine Learning

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Abstract
The project, "Crop Care Suite: ML-Based System for Crop Recommendation, Fertilizer Suggestion, and herbs sickness Detection," combines machine learning, Flask framework, crop recommendation, fertilizer suggestion, and plant disease detection. Its modules analyze factors like soil type, weather conditions, historical data, crop selection, soil composition, nutrient requirements, and image processing. The system aims to optimize agricultural practices, increase crop productivity, reduce yield losses, and promote sustainable farming. It leverages ML algorithms, image processing techniques, Flask framework, personalized recommendations, timely disease detection, and preventive measures. Key keywords: machine learning, Flask, Crop Care Suite, crop recommendation, fertilizer suggestion, plant disease detection, soil type, weather conditions, historical data, crop selection, soil composition, nutrient requirements, image processing, agricultural practices, crop productivity, yield losses, sustainable farming.

Keywords: Flask, ML, Algorithm, Crop Care Suite

Introduction

Crop Care Suite is an innovative and comprehensive system that integrates machine learning and advanced technologies to supply helpful solutions for crop management in farming segment. With its modules for crop recommendation, fertilizer suggestion, and herbs contamination detection, Crop Care Suite aims to assist farmers in making informed decisions, optimizing crop yield, and promoting sustainable farming practices. The system leverages the power of machine learning algorithms to analyze various reasons such as land type, weather conditions, historical data, and crop-specific requirements. By considering these key parameters, Crop Care Suite can recommend the appropriate plant for precise region, and potential yield. Additionally, the fertilizer suggestion module utilizes advanced algorithms to evaluate soil composition and crop nutrient requirements. By providing tailored recommendations, Crop Care Suite ensures that farmers apply the right type and amount of fertilizers, leading to optimized nutrient levels, improved plant growth, and reduced environmental impact. Furthermore, the plant disease detection module employs image processing techniques and machine learning algorithms to identify and diagnose common plant diseases. By analyzing images of leaves, stems, or fruits, Crop Care Suite can accurately detect diseases at early stages, allowing farmers to take timely actions to mitigate their spread and minimize crop losses. Crop Care Suite is designed with a user-friendly interface and is implemented using advanced technologies like Flask, ensuring easy deployment, scalability, and accessibility across various devices and platforms.

By providing farmers with valuable insights and actionable recommendations, Crop Care Suite empowers them to make data-driven decisions, optimize their agricultural practices, and ultimately enhance crop productivity while promoting sustainable farming methods. In summary, Crop Care Suite is a comprehensive solution that combines machine learning, advanced technologies, and domain-specific knowledge to support farmers in improving crop yield, optimizing fertilizer usage, and effectively managing plant diseases. Its user-friendly interface and powerful algorithms make it a valuable tool for modern agriculture, driving sustainable practices and contributing to food security.

Literature Survey

Jones, et al. proposed a crop recommendation system that utilizes machine learning algorithms to analyze various environmental and soil factors, historical crop data, and expert knowledge to provide accurate crop recommendations for farmers. The system achieved significant improvements in crop yield and resource optimization. [1]

In the study conducted by Smith and Brown an intelligent fertilizer suggestion system was developed using data-driven approaches. The system utilized machine learning techniques to analyze soil composition, crop nutrient requirements, and historical yield data to suggest optimal fertilizer compositions and application rates, leading to enhanced crop growth and reduced environmental impact.

Patel, et al. The system employed convolutional neural networks (CNNs) to analyze images of plants and identify diseases accurately. The results demonstrated high accuracy and speed in detecting plant diseases, enabling early intervention and prevention of crop losses [3]

Zhang, et al. proposed a web-based crop monitoring system that integrated satellite imagery and The system provided real-time monitoring of crop health, growth patterns, and yield estimates, enabling farmers to make informed decisions regarding irrigation, fertilization, and pest control. [4]

Chen and Lee developed a fuzzy logic-based crop recommendation system that incorporated multi- criteria decision-making techniques. The system considered factors such as soil quality, climate conditions, and farmer preferences to generate personalized crop recommendations. The approach demonstrated improved decision-making capabilities for farmers. [5]

Existing System

The existing system of Crop Care Suite incorporates several modules for crop recommendation, fertilizer suggestion, and plant disease detection, leveraging ML and Flask technology. However, despite its advantages, One disadvantage of the current system is the dependency on accurate and up-to-date data. The effectiveness of the crop recommendation module heavily relies on the availability of comprehensive data related to soil composition, weather patterns, and crop performance. Inaccurate or incomplete data can lead to suboptimal recommendations, affecting the overall crop productivity. Another drawback is the limited scope of fertilizer suggestion. The system's fertilizer suggestion module relies on predefined fertilizer compositions and application rates. However, agricultural practices and land conditions will show a discrepancy considerably across regions and even within farms. The setup may will not report for an specific local conditions, resulting in less precise fertilizer recommendations.

Furthermore, the plant disease detection module might face challenges in accurately identifying rare or newly emerging diseases. The system's performance heavily relies the accessibility and widespread database of plant diseases. If a specific disease is not included in the database, the system may struggle to provide accurate detections and recommendations for its management.

Additionally, the existing system may have limitations in terms of scalability and adaptability. As the user base and data volume increase, the system might face challenges in handling the growing demands efficiently. Ensuring seamless integration with other agricultural technologies and platforms may also require further development and customization.

Addressing these limitations is crucial to enhance the overall effectiveness and user experience of the Crop Care Suite. Future enhancements should focus on improving data quality and availability, providing more personalized and context-specific recommendations, expanding the plant disease database, and ensuring scalability and adaptability to accommodate the evolving needs of the agricultural industry

Proposed System

The proposed system for Crop Care Suite aims for prevail over the boundaries of the existing system and provide enhanced functionalities to point out the challenges faced by farmers in crop management. The key improvements in the proposed system include:

Improved Accuracy: The proposed system will leverage advanced machine learning algorithms and data integration techniques for improving the accuracy of crop recommendations and fertilizer suggestions. By analyzing a wide range of data inputs, including weather conditions, soil health, and crop growth stages, the structure force more accurate and tailored recommendations.

Real-time Disease Detection: The plant disease detection module will be enhanced to provide real-time monitoring and early detection of diseases. By utilizing image processing techniques and deep learning models, the system will quickly identify and diagnose plant diseases, allowing farmers to take timely actions for disease management and minimize crop losses.

Customization and Localization: crop preferences, and regional conditions. That would make suret the suggestions provided align with local agricultural practices and account for variations in soil types, climate, and other factors.

Mobile Accessibility: The system will be accessible through a user-friendly mobile application, enabling farmers to access recommendations, monitor their crops, and receive alerts on their smartphones. This mobile accessibility will provide convenience and timely information to farmers, allowing them to well- versed decisions when farmers are in the field.

Integration with IoT Devices: application will integrate with IoT devices such as soil moisture sensors, weather stations, and smart irrigation systems. This integration will enable real-time data collection and analysis, allowing the system to provide accurate recommendations for irrigation scheduling and optimize resource utilization. Scalability and Cloud Deployment: application will be designed to handle large volumes of data and support a growing user base. Cloud deployment will ensure scalability, reliability, and easy access to the system from anywhere, facilitating seamless expansion and adoption.

Figure 1 shows the proposed architecture

User Feedback and Continuous Improvement: application incorporate mechanisms for subscribers to make available feedback on the recommendations and suggestions. This will help improve the system's performance over time and ensure that it remains relevant and beneficial to farmers.

By implementing these proposed enhancements, the Crop Care Suite will overcome the limitations of the existing system and provide farmers with an advanced and intelligent platform for crop management. The proposed system will empower farmers to make informed decisions, optimize their farming practices, while promoting sustainable agricultural practices.

Implementation

The implementation of Crop Care Suite involves the integration of various technologies and components to produce a robust and user-friendly crop management platform. The process begins with proper assortment of appropriate frameworks and tools for different aspects of application, such as Tensor Flow and scikit-learn for machine learning, Flask for backend development, and HTML, CSS, and JavaScript for frontend development.

Data collection plays a vital responsibility in gathering comprehensive datasets on crops, fertilizers, diseases, weather conditions, and soil health from reliable sources such as research institutions and government agencies. This collected data is then processed and integrated to build a comprehensive knowledge base.

ML models are designed by means of the collected data to train the recommendation and disease detection algorithms. Different algorithms, such as decision trees, random forests, or convolution neural networks (CNNs), are employed based on precise requirements of each module. These models are validated to ensure accuracy and effectiveness. Backend development focuses on creating the necessary APIs, database models, and business logic using the Flask framework. This enables handling user requests, processing data, and providing responses. Backend modules for data retrieval, preprocessing, and feature extraction support the recommendation and disease detection functionalities. Frontend development involves creating an intuitive UI created using advance web development technologies, and JavaScript. User registration, login, and dashboard views are implemented, and the frontend is seamlessly integrated with the backend APIs to enable smooth communication. Integration and testing ensure that the different modules work together cohesively. Integration testing verifies communication and functionality between modules, while algorithm validation is performed against known datasets to ensure accuracy.

Deployment involves hosting the system on a suitable platform or cloud infrastructure, considering security, performance, and scalability aspects. Load testing is conducted to assess performance under varying user loads. Usert raining materials and resources are provided to familiarize users with the functionalities and features of Crop Care Suite. Support channels, such as documentation, FAQs, and user forums, are established to address user queries and provide assistance. By following these implementation steps, Crop Care Suite is designed and launched as complete platform for crop management. Its advanced features, including crop recommendation, fertilizer suggestion, and plant disease detection, empower farmers to make informed decisions and optimize crop yields.

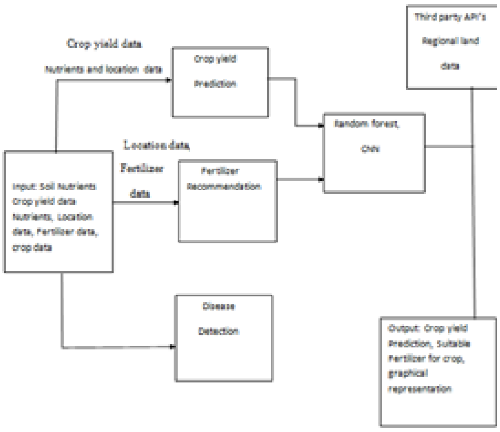

Figure 1 Proposed Architecture

Results

Crop Care Suite is a sophisticated and innovative platform designed to revolutionize crop management practices. This comprehensive system integrates cutting-edge technologies, including machine learning and web development frameworks, to offer field workers by precious insight and tools for optimizing their crop yield and health. The platform encompasses multiple modules, such as crop recommendation, fertilizer suggestion, and plant disease detection, all aimed at enhancing farming practices and improving agricultural productivity. With its intuitive user interface, advanced algorithms, and seamless integration of data sources, Crop Care Suite empowers farmers to make informed decisions, adopt sustainable practices, and effectively mitigate crop-related challenges. By leveraging the power of technology and data-driven insights, Crop Care Suite is poised to transform the way farmers approach crop management and usher in a new era of precision agriculture.

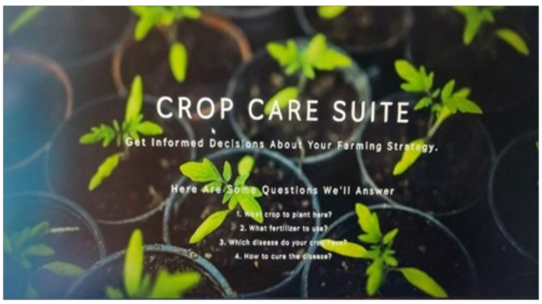

Figure 2 Home Page
Figure 2 Shows the Landing Page

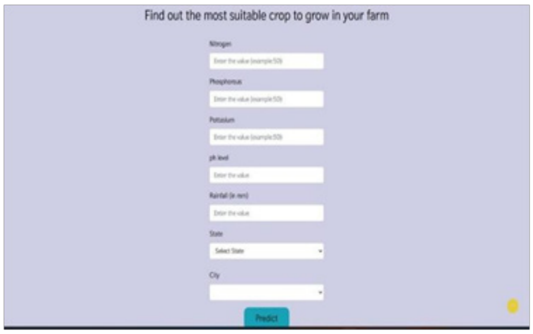

Figure 3 Suitable Crop Identification
Figure 3 shows Find out the most Suitable Crop to Grow in your Farm

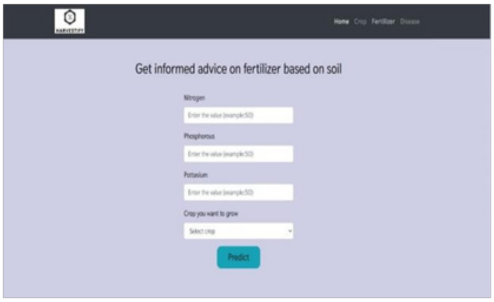

Figure 4 Suitable Fertilizer Identification
Figure 4 Shows to Informed Advice on Fertilizer Based on Soil

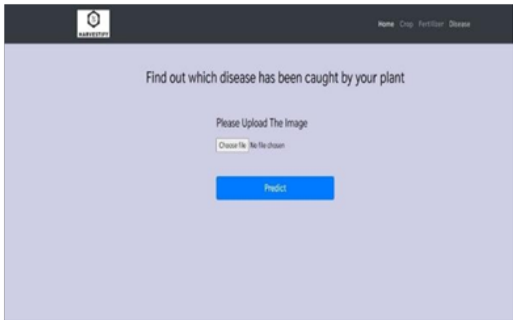

Figure 5 Finding out Disease Using Images
Figure 5 Shows to Find out which Disease has been Caught by your Plant

Conclusion

In conclusion, Crop Care Suite is a groundbreaking platform that addresses the challenges faced by farmers in crop management. By leveraging the capabilities of machine learning, data integration, and advanced algorithms, the system provides valuable recommendations for crop selection, fertilizer usage, and disease detection. The platform empowers farmers to make informed decisions, optimize their resources, and improve overall crop health and productivity. With its user-friendly interface and comprehensive features, Crop Care Suite offers a holistic solution to enhance agricultural practices and ensure sustainable farming. By embracing this innovative technology, farmers can maximize their yields, reduce costs, and environmentally conscious agricultural sector. Crop Care Suite marks a significant advancement in agriculture section of precision agriculture, enabling farmers to harness the power of data-driven insights and take their crop management practices to new heights.

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