

Smart Crop Advisory System for Small and Marginal Farmers

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ABSTRACT

Agriculture remains a primary source of livelihood for a large population, especially in developing countries.

However, small and marginal farmers often face difficulties due to unpredictable climatic conditions, lack of proper guidance, and limited access to modern agricultural technologies.

This paper presents a Smart Crop Advisory System designed to support farmers in making informed decisions throughout the farming cycle. The system uses soil parameters such as nitrogen, phosphorus, potassium, and pH values along with environmental factors like temperature and rainfall to recommend suitable crops.

In addition, an image-based disease detection module is implemented to identify plant diseases at an early stage and suggest remedies.

The system also provides weather updates and basic market insights to improve planning and profitability.

The proposed approach aims to reduce crop loss, improve productivity, and promote sustainable farming practices.

Keywords: Smart Agriculture, Crop Recommendation, Disease Detection, Machine Learning, Precision Farming

I. INTRODUCTION

Agriculture is one of the most important sectors supporting the livelihood of people, especially in rural areas. In countries like India, a majority of farmers belong to the small and marginal category, owning limited land and resources.

These farmers often depend on traditional knowledge and past experience for farming decisions.

However, modern agriculture faces several challenges such as unpredictable weather conditions, soil degradation, pest attacks, and fluctuating market prices.

Due to the lack of timely and accurate information, farmers may select unsuitable crops, apply incorrect fertilizers, or fail to identify diseases at an early stage. These issues directly affect productivity and income.

With the growth of digital technologies, there is an opportunity to improve agricultural practices using data-driven approaches. The Smart Crop Advisory System is designed to provide farmers with reliable recommendations based on scientific data. It acts as a support system that assists farmers in selecting appropriate crops, detecting plant diseases understanding environmental conditions.

The main objective of this system is to reduce uncertainty in farming and help farmers make better decisions using simple and accessible technology.

II. LITERATURE REVIEW

Agricultural advisory systems have traditionally relied on manual methods such as guidance from experts and government extension services. While these methods provide useful information, they are often generalized and may not address the specific needs of individual farmers. In addition, limited availability of experts and delays in communication reduce their effectiveness in real-time farming situations.

With the advancement of technology, several digital solutions have been developed to support farmers. Many mobile applications provide weather updates, market prices, and basic crop information. Research studies have also shown that machine learning techniques can be used to recommend suitable crops based on soil and environmental conditions. Similarly, deep learning models like Convolutional Neural Networks (CNN) are widely used for plant disease detection through image analysis.

However, most existing systems focus on only one aspect of agriculture and lack integration. Farmers often need to use multiple platforms to get complete information, which can be inconvenient. The proposed Smart Crop Advisory System addresses this gap by combining crop recommendation, disease detection, and weather information into a single, easy-to-use platform, making it more practical for small and marginal farmers.

III. METHODOLOGY

The methodology of the Smart Crop Advisory System is designed in a systematic manner to ensure accurate and reliable results. The process begins with the collection of agricultural data from various sources. This includes soil parameters such as nitrogen, phosphorus, potassium, and pH values, along with environmental factors like temperature and rainfall. In addition, a dataset of plant leaf images is collected to support the disease detection module.

Once the data is collected, it undergoes preprocessing to improve its quality and usability.

This step involves handling missing values, removing inconsistencies, and normalizing numerical data. For image data, preprocessing techniques such as resizing and enhancement are applied to ensure better performance of the model. After preprocessing, machine learning techniques are used to develop the crop recommendation model.

The model analyzes the relationship between soil conditions and suitable crops, and based on the input provided by the farmer, it suggests the most appropriate crops for cultivation.

This helps in improving yield and reducing the risk of crop failure.

For disease detection, an image-based approach is used. Farmers can upload images of plant leaves, which are then analyzed using a trained model.

The system identifies patterns such as spots, discoloration, or texture changes to determine whether the plant is healthy or affected by a disease. It also provides basic suggestions for treatment.

The system is implemented using a user-friendly interface that allows farmers to easily input data and view results.

A backend server processes the data and communicates with the machine learning models to generate predictions. Additionally, the system integrates external services to provide weather

updates and other useful information. Finally, the output generated by the system is displayed in a simple and understandable format, enabling farmers to make informed decisions. This step-by-step methodology ensures that the system is efficient, accurate, and easy to use for small and marginal farmers.

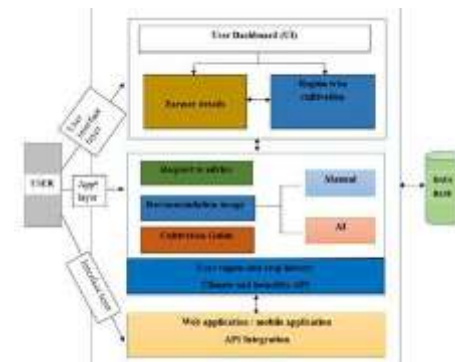


FIGURE 3.1.1:ARCHITECTURE

IV. RESULTS

4.1 Crop Advisory



FIGURE 4.1.1 : Smart Advisory page for entering farm and soil details

4.2 Disease Detector



FIGURE 4.2.1 : Disease detection result indicating a healthy crop.

4.3 Market Insights



FIGURE 4.3.1 : Crop price comparison chart

V. CONCLUSION

The Smart Crop Advisory System provides an effective solution to the challenges faced by small and marginal farmers. By using soil parameters, environmental conditions, and machine learning techniques, the system helps in recommending suitable crops and improving agricultural productivity. The inclusion of a disease detection module further supports farmers by identifying plant health issues at an early stage and suggesting basic remedies.

The system is designed to be simple and user-friendly, making it accessible even to farmers with limited technical knowledge. It reduces dependency on traditional guess-based methods and enables data-driven decision-making. Overall, the project contributes to improving efficiency, reducing crop losses, and supporting sustainable farming practices.

VI. REFERENCES

Mohanty, S. P., Hughes, D. P., and Salathé, M., “Using Deep Learning for Image-Based Plant Disease Detection,” published in *Frontiers in Plant Science*, 2016, provided important insights into image-based disease detection using deep learning techniques, which influenced the design of the disease detection module in this project.

Goodfellow, I., Bengio, Y., and Courville, A., in their book *Deep Learning*, MIT Press, 2016, offered foundational knowledge on neural networks and deep learning concepts that support the implementation of intelligent models in this system.

The Scikit-learn Developers’ work on *Machine Learning in Python* (2023) contributed to understanding and implementing machine learning algorithms for crop recommendation.

The TensorFlow Team’s research on *Deep Learning and Image Classification Techniques* (2023) helped in building and understanding the image processing model used for plant disease detection.

Guidelines from the Food and Agriculture Organization in the *E-Agriculture Strategy Guide* provided valuable information about agricultural practices and the role of digital technologies in farming systems.