Optimizing Crop Prediction using ML and DL

Prof. N. L. Bhale[1], Sahil V. Shaikh[2], Ayush M. Wagh[3], Amar D. Patait[4], Moiz S. Shaikh[5]

Department of Information Technology
Matoshri College of Engineering and Research Center, Eklahare, Nashik, Maharashtra, India

Abstract

The Crop Yield Prediction and Fertilizer Recommendation System using Hybrid Machine Learning Algorithms is an innovative solution designed to enhance agricultural practices and increase crop productivity. This system leverages a combination of machine learning techniques, including both traditional statistical models and advanced deep learning algorithms, to accurately forecast crop yields. By analyzing historical data, environmental factors, and crop-specific information, the system predicts future yields, helping farmers make informed decisions about planting, harvesting, and resource allocation. Furthermore, the system incorporates a fertilizer recommendation component, which suggests the optimal type and quantity of fertilizers based on soil nutrient analysis and crop requirements, promoting efficient resource management and sustainability. This hybrid approach offers a comprehensive and data-driven solution for precision agriculture, improving crop yield while minimizing the environmental impact of excessive fertilizer use.

Keywords: Crop yield prediction, Machine learning, Disease Prediction, Fertilizer recommendation

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INTRODUCTION

The creation of the farmer portal described in the provided information is undeniably relevant in today's agricultural landscape. With the global population on the rise and climate change impacting traditional farming practices, technology-driven solutions are critical to ensuring food security and the livelihoods of farmers. The portal's compilation of government schemes information is particularly pertinent, as it can empower farmers with knowledge of available support programs and subsidies, enabling them to make informed decisions and access vital resources to improve their agricultural practices. Furthermore, the integration of cutting-edge machine learning for crop prediction and image-based disease detection directly addresses the challenges of uncertain weather patterns and crop diseases, which can significantly impact crop yields. By harnessing these advanced technologies, farmers can enhance their productivity and resilience in the face of changing environmental conditions, ultimately contributing to the sustainability of agriculture. Additionally, the inclusion of a Marathi language system in the portal acknowledges the importance of linguistic diversity and local context in agricultural development. In a region like Maharashtra, where Marathi is widely spoken, this feature ensures that farmers, regardless of their linguistic background, can readily access and benefit from the portal's resources. In essence, this farmer portal offers a holistic solution that aligns with the evolving needs of the agricultural sector by providing essential information, predictive capabilities, disease management, and linguistic accessibility. As such, it serves as a

timely and relevant tool to empower farmers, enhance agricultural productivity, and advance the broader goals of food security and rural development. In an era marked by technological innovation and the imperative of sustainable agriculture, the creation of a comprehensive farmer portal stands as a beacon of progress in the farming community. Agriculture, the backbone of many economies, faces a myriad of challenges, from unpredictable weather patterns to the relentless spread of crop diseases. Furthermore, ensuring equitable access to government support and resources remains a critical concern for farmers around the world. In response to these challenges, the development of an integrated farmer portal has emerged as a transformative solution, offering an array of indispensable features designed to empower and uplift farming communities. This portal represents a holistic approach to addressing the multifaceted needs of farmers. It not only provides vital information on government schemes and policies but also harnesses the power of machine learning for crop prediction, leverages advanced computer vision for disease detection, and ensures linguistic inclusivity through a dedicated Marathi language system. This introduction serves as a gateway to explore the myriad ways in which this farmer portal is poised to revolutionize agriculture, offering farmers in Maharashtra, India, and beyond the tools and knowledge they need to thrive in an ever-changing agricultural landscape. Through this technological leap, we embark on a journey toward sustainable farming, increased food security, and improved livelihoods for those who toil tirelessly to feed our nations.

LITURATURE SURVEY

• Pallavi Saindane SwasthPhasal: An E-farming Web Portal, 2022 Second International Conference on Advanced Technologies in Intelligent Control, Environment, Computing Communication Engineering (ICATIECE) Agriculture has been India's main profession for centuries. According to the Indian Agricultural Research Institute, the need for edible grains will increase to 345 million tones in the next decade, however its role in India's GDP has recently declined. The current situation of farmers is disappointing as most of them live in severe poverty. They have to take loans to make ends meet and at times it becomes difficult to repay the loan. Our portal aims at providing crop seeds and fertilizers at cheap prices. The option of renting farming equipment would also be available. The cutting-edge technology which has been used over the past few years, has been lagging when it comes to farming. The main reason for this is both the disregard of these technologies and also the inaccessibility. Though farmers strive hard, even in this 21st century, they are bamboozled by third party retailers, which increases their poverty. In this covid pandemic, there was a huge demand for the agricultural products but it was difficult to get all the materials as well as information online. The solution to all the problems is Agro marketing which would make everything easy and secure. E-Farming provides a way for farmers to buy produce with only a basic knowledge of how to use the internet. This website is a centralized approach to guide farmers in all aspects and display current market prices of various products without brokers' cost. It will also include various government agricultural programs and access to new cultivation techniques.[1]

• Faudziah Ahmad; Nur Haryani Zakaria, Transforming Information Based Agricultural Portal to Knowledge- Based Agricultural Hub, Transforming Information- Based Agricultural Portal to Knowledge-Based Agricultural Hub The paper proposes an approach to transform an information based portal into a knowledge- based hub. The study is made on the Agribazaar, which is an information-based portal provided by the Department of Agriculture, Ministry of Agriculture and Agri-based Industry, Malaysia. Basically, the portal has been developed to offer an internet-based commerce infrastructure for buyers and sellers of agriculture products. Agribazaar has been found to be successful in bridging the rural connectivity between users locally and globally. The applications has been accepted and utilized by a substantial number of users in Malaysia and other countries as well. However, the percentage of usage of the portal could be increased if it is made more competitive. One way to obtain a greater percentage of market shares is to reconstruct the

portal into a new paradigm which is known as a ”knowledge-based” hub. The transformation approach proposed involves five stages namely data repository, metadata, knowledge-based services, application, and security.[2]

• K P K Devan; B Swetha , Crop Yield Prediction and Fertilizer Recommendation System Using Hybrid Machine Learning Algorithms Progressions in machine learning and crop simulation techniques have created new opportunities for improving agro-based prediction. In crop yield analysis, machine learning is a rapidly expanding research area. Predicting yield is a crucial issue in agriculture. Machine learning (ML), on the other hand, aims to make forecast by discovering associations between input and response variables. Various elements, including weather and soil, are making it challenging for farmers to cultivate crops. Developing effective agricultural and food policies on a regional and international scale requires accurate crop yield forecasts. Our proposed solution combines two machine learning algorithms to optimize agriculture by predicting crop yield and recommending fertilizer. This script is innovative because it allows the user to predict the most suitable crop based on basic information such as soil characteristics and weather conditions. We have utilized Random Forest and Logistic Regression for the system’s implementation. This model serves as an example of hybrid ML approaches which could solve the above mentioned issues and increase the yield.[3]

AIM & OBJECTIVES

Enhance User Education and Training: Provide comprehensive tutorials and training materials on the platform to educate farmers on how to effectively use the provided tools and resources. This objective promotes user adoption and ensures farmers can make the most of the platform. MCERC 3 Optimizing Crop Prediction Using ML and DL

8. Facilitate Seamless Government Interaction: Enable farmers to apply for government schemes and subsidies directly through the platform, reducing bureaucratic hurdles and paperwork. This objective simplifies administrative processes and increases the efficiency of government-farmer interactions.

9. Encourage Sustainable Farming Practices: Integrate sustainability guidelines and practices into the platform to educate farmers on environmentally friendly farming methods. This objective promotes responsible agriculture and reduces the ecological footprint of farming activities.

10. Establish Feedback Mechanisms: Implement a feedback system that allows farmers to provide input and suggestions for platform improvements. This objective ensures continuous refinement and customization of the platform based on user needs and preferences.

11. Foster Community Engagement: Create online forums, discussion boards, or social networking features within the platform to encourage farmers to share their experiences, knowledge, and best practices with each other. This objective promotes a sense of community and peer learning among farmers.

12. Ensure Data Privacy and Security: Implement robust data security measures to protect farmers’ sensitive information and maintain their trust in the platform. This objective is essential to safeguard user data and maintain compliance with relevant regulations.

13. These objectives collectively aim to create a comprehensive and user-centric agricultural support platform that empowers farmers and enhances their agricultural practices

MOTIVATION

The motivation behind embarking on the development of the comprehensive farmer portal is deeply rooted in a profound understanding of the challenges faced by farmers and a commitment to transforming these challenges into opportunities. Agriculture, as the cornerstone of our societies, not only feeds us but sustains livelihoods and economies. Yet, it grapples with the uncertainties of climate change, the complexity of

government policies, and the ever-present threat of crop diseases. These challenges can seem insurmountable, but they also present a call to action, an opportunity to innovate, and a chance to empower those who till the land. At the heart of this project is a driving desire to bridge the information gap and provide farmers with the knowledge they need to make informed decisions. The portal's provision of government schemes information aims to ensure that no farmer is left behind, that every farmer has access to the support and resources they are entitled to. The incorporation of cutting-edge technology, such as machine learning for crop prediction and image- based disease detection, is a testament to our belief that technology can be harnessed to mitigate the impacts of climate change and crop diseases. It represents a commitment to increasing agricultural productivity while reducing environmental impact. Moreover, the dedication to linguistic inclusivity through the Marathi language system reflects an understanding that solutions must be accessible to all, regardless of linguistic background. In Maharashtra, this feature has the potential to empower millions of Marathi-speaking farmers who have unique needs and challenges. This project's motivation is deeply rooted in the belief that through innovation, information, and inclusivity, we can usher in a new era of agriculture, one where farmers have the tools and support they need to thrive, ensuring food security and prosperity for generations to come.

APPLICATION:

1. Farmers
2. Agricultural Researchers
3. Government sector

SYSTEM ARCHITECTURE

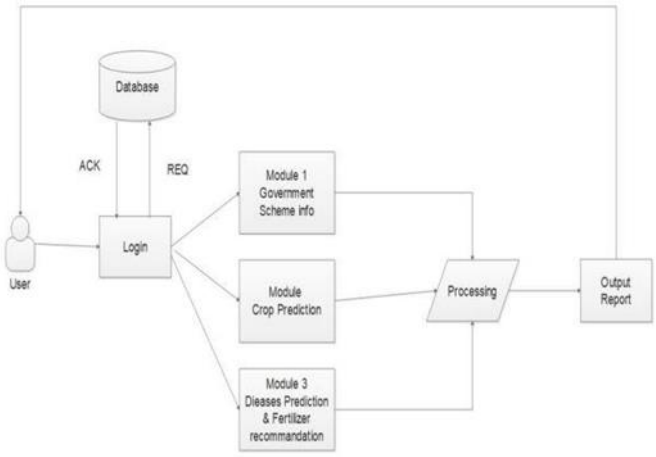

Fig -1: System Architecture Diagram

ADVANTAGES

1. Enhance Access to Government Support: The primary objective is to provide farmers with a user-friendly platform where they can readily access information about government schemes, subsidies, and policies. This aims to ensure that every eligible farmer can benefit from the support and resources available to them.

2. Empower Informed Decision-Making: Enable farmers to make data-driven decisions by offering them accurate crop predictions based on historical data, weather patterns, and soil conditions. This objective seeks to optimize crop selection, planting schedules, and harvesting strategies for improved productivity.
3. Early Disease Detection and Mitigation: Develop a robust image-based disease prediction system that employs advanced computer vision to identify and diagnose crop diseases promptly. This objective aims to minimize crop losses by facilitating early intervention and treatment.
4. Optimize Nutrient Management: Implement a fertilizer recommendation system that utilizes data-driven insights to suggest personalized fertilizer blends based on soil analysis and crop type. This objective promotes efficient nutrient management practices, reducing costs and environmental impact.
5. Linguistic Inclusivity: Establish a dedicated Marathi language system within the portal to cater to the linguistic diversity of the farming community in Maharashtra. This objective ensures that farmers who primarily speak Marathi can access and benefit from the portal's resources, breaking down language barriers.
6. Improve Accessibility for Rural Areas: Develop mobile applications and offline access options to ensure that even farmers in remote and low-connectivity regions can access the platform and its resources. This objective aims to bridge the digital divide and reach underserved farming communities.

FUNCTIONAL & NON-FUNCTIONAL REQUIREMENTS

Nonfunctional Requirements Performance:

Response Time: The system should provide real-time or near-real-time predictions and recommendations to ensure timely decision-making for farmers.

Scalability: The system should be able to handle an increasing amount of data and user requests as the user base grows without a significant degradation in performance.

Availability: The system should have a high level of availability, minimizing downtime to ensure that farmers can access predictions and recommendations whenever needed.

Fault Tolerance: The system should be designed to handle errors gracefully and recover from failures without losing critical data.

Usability:

User Interface: The system should have an intuitive and user-friendly interface, making it accessible to users with varying levels of technical expertise.

Training and Support: Provide training materials and support resources for users to understand and effectively use the system.

Scalability:

Data Storage: The system should be capable of handling large volumes of historical data, environmental data, and user information efficiently.

Algorithm Scalability: Ensure that machine learning algorithms can scale with the increasing size of the dataset and computational requirements.

Interoperability:

Integration: The system should be capable of integrating with other agricultural management tools and systems that farmers may use for a seamless user experience.

The functional requirements of the Crop Yield Prediction and Fertilizer Recommendation System outlined in the abstract are as follows:

Functional Requirements:

Requirement: The system should be able to collect and integrate relevant data, including historical crop yield data, environmental factors (e.g., weather conditions), and crop-specific information. Accurate predictions depend on the availability and integration of comprehensive and up- to-date data.

Machine Learning Model Integration:

The system must incorporate both traditional statistical models and advanced deep learning algorithms for crop yield prediction.

A hybrid approach ensures a robust and accurate prediction model, leveraging the strengths of both traditional and advanced machine learning techniques.

User Interface:

The system should have a user-friendly interface for farmers to interact with and receive prediction. A user-friendly interface facilitates adoption by farmers and ensures effective utilization of the system.

Security and Privacy:

The system should ensure the security and privacy of the agricultural data collected.

Protecting sensitive data is critical to gaining and maintaining the trust of farmers and stakeholders in the agricultural sector.

These functional requirements collectively define the capabilities and features needed for the successful implementation and operation of the Crop Yield Prediction and Fertilizer Recommendation System.

SYSTEM REQUIREMENTS

Software Used:

- Windows 7 or above • Vscode, Xamp • Python • Django

Hardware Used:

- AMD/Intel i3 Processor or above Processor
- 4GB RAM for application development
- 150 GB or above Hard Disk

CONCLUSION

In conclusion, the comprehensive farmer portal represents a pivotal step towards harnessing technology to revolutionize agriculture in Maharashtra, India. By offering a range of innovative features such as crop prediction, disease detection, fertilizer recommendations, and government scheme information, the portal empowers farmers with data-driven insights, ultimately enhancing productivity, reducing risks, and improving their livelihoods. Its commitment to linguistic inclusivity through the Marathi language interface ensures accessibility for a wider farming community. While it holds great promise, addressing potential challenges related to the digital divide and data security will be crucial for its successful implementation and impact on sustainable agriculture and food security in the region. In addition to its immediate benefits for farmers, the comprehensive farmer portal also holds the potential to drive broader agricultural transformation. The platform's data collection and analysis capabilities can contribute valuable insights into regional agricultural trends and challenges. This data can inform policymakers, researchers, and agricultural extension services, enabling evidence-based decision-making and targeted interventions. By fostering collaboration between various stakeholders in the agricultural ecosystem, the platform can play a pivotal role in shaping more resilient and sustainable agricultural practices, not only in Maharashtra but potentially serving as a model for other regions facing similar agricultural challenges. However, the success of this ambitious endeavor hinges on addressing several critical factors. Firstly, bridging the digital divide is essential to ensure that even remote and marginalized farming communities can benefit from the platform. Providing affordable internet access, offering training and support for digital literacy, and developing offline access options are key steps in this regard. Secondly, safeguarding data privacy and security is paramount. Farmers' personal and agricultural data must be protected from unauthorized access and misuse.

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