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Smart Crop System-Survey

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Abstract: Smart Crop System is web application that integrates several machine learning algorithms with recommendation systems. It mainly includes two main modules Crop Data Analytics [CDA] and Crop Recommendation System [CDS]. It seeks to offer a range of solutions to the issues the agriculture sector faces. The web application provides a number of options, such as Crop seasonal analytics, crop detection, and disease detection. Recommendation solutions include techniques such as regression, whereas detection solutions involve image pre-processing stages including contour detection, Normalization, and CNN model. Using resources from OpenCV and Open AI, this system seeks to reduce the amount of time needed for crop diagnostics and crop recommendations for the upcoming seasons.

***Index Terms* --** CDA, CRS, OpenCV, Open AI, Normalization.

I. Introduction

Various crop recommendation systems have been developed to assist farmers in making informed decisions about crop selection based on specific environmental factors. One notable system is Climate Field View, provided by The Climate Corporation, a subsidiary of Bayer. Climate Field View employs advanced analytics, incorporating satellite imagery, weather data, and field information, to offer insights into crop health and yield predictions. This allows farmers to make data-driven choices regarding planting, fertilization, and harvesting, optimizing resource usage and increasing overall agricultural productivity. Additionally, IBM Watson Decision Platform for Agriculture is another prominent system that utilizes AI and machine learning to analyze data from multiple sources, including weather, satellite imagery, and IoT devices. By providing comprehensive recommendations for crop management and pest control, IBM's platform empowers farmers to adapt to changing conditions and improve their overall farming practices.

In the realm of crop disease detection, several systems leverage cutting-edge technologies to identify and manage diseases affecting agricultural yields. Plantix is a noteworthy mobile app that employs image recognition and machine learning to identify crop diseases and nutrient deficiencies. Farmers can capture images of plant leaves using their smartphones, and the app provides detailed information about the specific issue along with recommended treatments. Another system, Agri Circle, focuses on crop monitoring and disease detection by utilizing remote sensing technology and machine learning algorithms. By analyzing satellite and drone imagery, Agri Circle provides early detection of diseases, enabling prompt intervention and preventing widespread crop damage. These existing systems represent significant strides in agricultural technology, offering farmers valuable tools to enhance decision-making and improve overall crop health.

The existing agricultural system faces various limitations that hinder its efficiency and effectiveness. Manual decision-making processes lacks data analytics and usage of AI for precision and productivity. Moreover, the underutilization of agricultural data leads to missed opportunities for informed decision-making and optimization. The absence of predictive analysis tools results in reactive rather than proactive approaches, while generic recommendations fail to cater the individual needs of different farmers. Additionally, the limited integration of advanced technologies like AI and machine learning withholds the possibility for an innovation and also decreases its efficiency. Heavy reliance on traditional farming experience may not align with modern scientific practices, and inadequate adaptation to changing climate patterns further increase vulnerabilities. Addressing these limitations is imperative to usher in a more advanced, data-driven approach to agriculture, as proposed by the Smart Crop System.

Whereas the proposed system represents an advanced, technology-driven approach to crop management and decision-making in agriculture. It harnesses the power of data analytics, artificial intelligence (AI), and machine learning to enhance agricultural practices. Here's a brief overview of the key aspects of the proposed system. The proposed system emphasizes data-driven decision-making, leveraging comprehensive agricultural data sources like weather data, satellite imagery, soil composition, and historical crop performance. Advanced machine learning algorithms are employed to develop predictive models for accurate forecasting of crop yields, disease outbreaks, and pest infestations. An intelligent recommender system suggests recommendations to individual farmers based on specific crop types, soil conditions, and local climate. This personalized advice optimizes decision-making. By analyzing data and patterns, the system helps optimize resource allocation, including water, fertilizers, and pesticides. The system offers real-time monitoring of crop health, allowing farmers to track the progress of their crops and promptly address any emerging issues. A user-friendly web and mobile interface provide an intuitive platform for farmers to access insights, visualize data, receive recommendations, and interact with the system seamlessly. The system integrates AI, machine learning, data analytics, and geospatial analysis to provide a comprehensive and holistic approach to crop management.

The proposed project also offers several advantages over the existing manual agricultural system. It prioritizes data-driven decision-making through comprehensive agricultural data analytics, enabling informed choices. Incorporating machine learning facilitates predictive analysis, accurately forecasting crop yields, disease outbreaks, and pest infestations. Personalized recommendations tailored to individual crop types, soil conditions, and local climate data enhance efficiency and productivity. By optimizing resource utilization and minimizing waste, the system promotes sustainable farming practices. Real-time monitoring ensures prompt intervention, while the integration of AI, machine learning, and data analytics provides a sophisticated approach. It adapts to climate change by analyzing climate data and mitigating risks, while its user-friendly interfaces enhance accessibility and interaction. Through fostering collaboration among farmers, researchers, and policymakers, the system encourages innovation, ultimately contributing to more sustainable and resilient agricultural practices.

II. Literature Survey

A Publication [1] described a system that was suggested to deal with the problem of keeping an eye on large agricultural regions, which are frequently miles long, where manual surveillance is not feasible. In order to notify farmers in a timely manner, the system integrates automated disease detection algorithms and uses remote sensing photos for continuous monitoring. Finding the infections as soon as they appear on the outer layers of leaves is the main objective. The system runs in two stages: real-time monitoring and disease identification using Canny's edge detection method, and training data sets containing both healthy and diseased samples.

Detecting crop diseases with picture segmentation Low-level picture [2] segmentation tasks have been solved by using K-Means clustering, as explained by Tushar H. Jaware, Ravindra D. Badgujar, and Prashant G. Patil. The goal of this convergent clustering technique is to optimize the partitioning choices made using an initial set of clusters that the user defines and that are updated at the end of each iteration. The majority of the green-coloured pixels are identified in the first step. The majority of the green pixels are then masked after these pixels are first masked according to particular threshold values that are calculated using Otsu's approach. The other extra step involved removing all of the pixels on the borders of the infected cluster as well as the pixels with zeros for red, green, and blue values. The outcomes of the experiment show that the proposed technique is a robust technique for the detection of plant leaves diseases.

Crop management with data analytics by [3] According to Nabila Chergui & Mohand Tahar Kechadi, the world's economic sectors are greatly impacted by the latest developments in information and communication technologies. The emergence of digital agriculture can be attributed to the increasing accessibility of digital devices and the progress made in artificial intelligence and data science. New methods for increasing farming's output and efficiency while protecting the environment were made possible by digital agriculture. In order to help farmers, agronomists, and other professionals comprehend farming chores and make better decisions, large volumes of agricultural statistics have been collected and analysed thanks to recent and sophisticated digital devices and data science. We provide a thorough analysis of data mining approaches applied to digital agriculture in this research. We present the yield of the crop while studying and continuously monitoring the crops. After identifying the main categories of data mining techniques for crop yield monitoring, we discuss a panoply of existing works on the use of data analytics. This is followed by a general analysis and discussion on the impact of big data on agriculture.

[4] In a literature survey we found spectral and imaging technology provide acumen about crop health and growth dynamics. This technology has been activated to various crops like soybean, rice, wheat for detecting chlorophyll, nitrogen content, to monitor crop pests and diseases, diagnosing stress factors and predicting crop yield. Data for chlorophyll content detection is acquired using aircraft-based, satellite-based sensing.

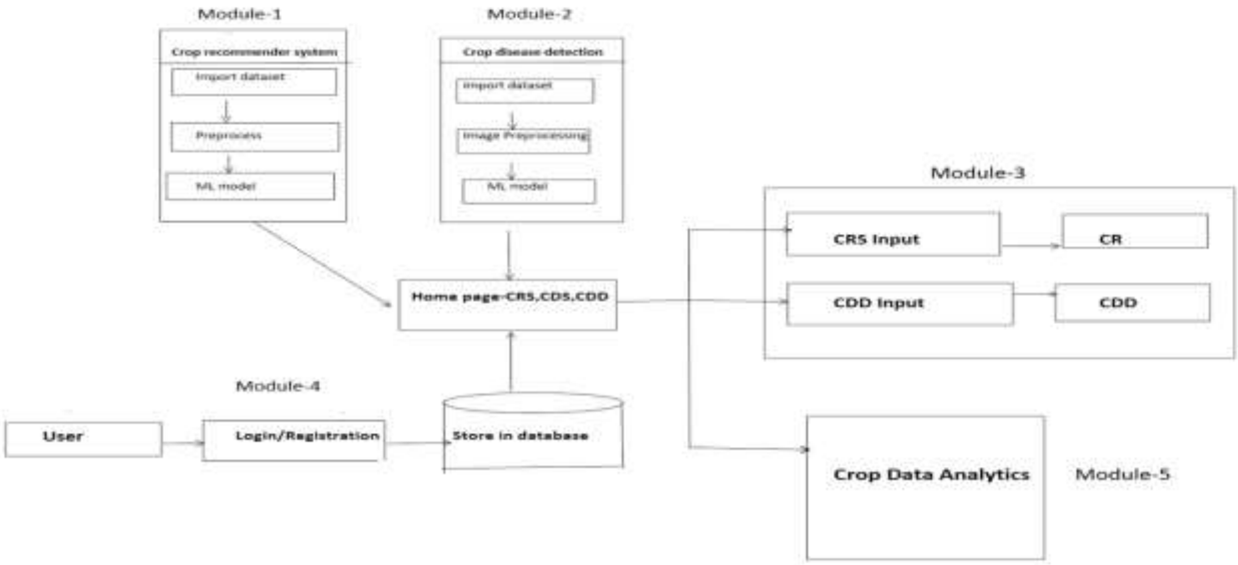
While referring to [5] we came across the importance of data mining in agriculture which includes crop yield analysis and prediction. This includes Chameleon clustering and regression for prediction. This is mainly to maximize rice yield production and how different factors play a role in the production. Technologies such as big data is also discussed in this paper.

We discovered a method for low-level picture segmentation that uses K-Means clustering to identify plant leaf diseases in a research report [6]. Based on initially specified clusters, partitioning options were optimized using the K-Means clustering technique. The procedure of finding and masking predominantly green-coloured pixels using particular thresholds calculated using Otsu's algorithm is described in the paper. To exclude pixels on the edges of the contaminated cluster and those with zero RGB values, the method involves extra stages. The experimental findings demonstrate the excellent accuracy rates of the suggested method for identifying illnesses of the plant leaves. The significance of utilizing technology to assist in the management of perennial fruit crops is also covered. It also demonstrates the texture computation and image segmentation and recognition processes. The proposed technique shows promise for efficient disease detection and classification.

A study [7] on combating crop diseases suggests a flexible approach that makes use of modified CNN models such as Inception-v3 and ResNet-152. The research demonstrated its versatility across several crops by achieving a high accuracy (97.48% - 99.10%) on a variety of datasets and successfully identifying illnesses in both rice and corn. Additional examination reveals rice disorders through main and minor subsets and demonstrates its capacity to manage various sorts of disease data. This robust technology holds great promise for raising crop yields, cutting losses, and equipping farmers with effective disease detection tools—all of which will pave the way for more intelligent and forward-thinking agricultural methods.

While looking for machine learning methods, we came across [8], which focuses mostly on analysing agricultural data and recommending appropriate fertilizer for certain crops using machine learning algorithms like Support Vector Machine and Random Forest. The primary goal was to develop a prediction model for future crop yields. It also covered the application of various machine learning approaches to future crop production estimation and emphasized the significance of yield prediction in agriculture. The suggested approach uses historical data to forecast crop productivity and makes fertilizer recommendations for certain crops. The impact of contemporary farming techniques on food security and seasonal climate conditions is also discussed in the article. The goal of the research is to increase crop productivity, and it suggests appropriate fertilizer for various crops according to the data.

III. SYSTEM ARCHITECTURE



IV. METHODOLOGY

The "Smart Crop System" revolutionizes agriculture by integrating data analytics and AI, empowering farmers with personalized insights for efficient and sustainable decision-making, moving beyond reliance on anecdotal evidence to foster precision in crop management. This paper has 5 modules:

Module 1- This module develops a crop recommendation system by importing a dataset, splitting it for training and testing, and training a random forest classifier to predict suitable crops based on agricultural features. It encapsulates the process from dataset importation to recommendation generation, aiding farmers in informed crop selection.

Module 2- This module integrates a crop disease image dataset by categorizing it into classes, employing TensorFlow or py Torch for efficient loading, and conducting meticulous pre-processing including resizing, normalization, and augmentation. The dataset is then split for training, validation, and testing, ensuring balanced representation and effective training of machine learning models for accurate disease detection.

Module 3- This module has the integration process which involves creating backend and frontend repositories, establishing routes and module functions, rendering HTML pages, styling with CSS and Bootstrap, importing saved model files, and connecting frontend input to backend output for ML model interaction within a Flask app. It culminates in seamless communication between frontend forms and backend event handlers for processing input and generating corresponding outputs.

Module 4: This module involves login and authentication where FLASK framework will be utilized to create a login and authentication page, featuring user attributes like User ID, email, and password, supported by services for user registration and authentication. MYSQL database integration ensures storage and retrieval of user information, facilitating seamless login and authentication functionality within the application.

Module-5: The crop data analytics module analyses crop-related data such as land area, crop percentage, fertilizer types, and soil properties including pH, nitrogen, and potassium levels, to determine crop yield and optimize agricultural outcomes. By considering these features, the module provides insights into crop requirements and soil health, facilitating informed decision-making for farmers to enhance productivity and sustainability.

V. CONCLUSION

In conclusion, the "Smart Crop System " project presents a transformative solution to the challenges facing modern agriculture. By harnessing the power of data analytics and artificial intelligence, this framework offers accurate predictions, personalized recommendations, and informed insights to farmers and agronomists. The anticipated outcomes of this project encompass increased crop yields, resource optimization, sustainable practices, and adaptability to changing climate conditions. The user-friendly interfaces empower stakeholders with accessible tools for data-driven decision making, contributing to food security, environmental preservation, and agricultural innovation. As this project bridges the gap between technology and agriculture, it holds the potential to reshape farming practices and enhance the well-being of farming communities on a global scale

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