CROP AND FERTILIZER RECOMMENDATION SYSTEM

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ABSTRACT

The impact of climate change in India, most of the agricultural crops are being badly affected in terms of their performance over a period of the last two decades. Predicting the crop yield in advance of its harvest would help the policy makers and farmers for taking appropriate measures for marketing and storage. This project will help the farmers to know the yield of their crop before cultivating onto the agricultural field and thus help them to make the appropriate decisions. The results of the prediction will be made available to the farmer. Thus, for such kinds of data analytics in crop prediction, there are different techniques or algorithms, and with the help of those algorithms we can predict crop yield. Random forest algorithm is used. In India, there are many ways to increase the economic growth in the field of agriculture. Data mining is also useful for predicting crop yield production. Generally, data Mining is the process of analyzing data from various viewpoints and summarizing it into important information. Random forest is the most popular and powerful supervised machine learning algorithm capable of performing both classification and regression tasks, that operate by constructing a multitude of decision trees during training time and generating output of the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees. Agriculture is the backbone of the Indian economy. In India, agricultural yield primarily depends on weather conditions. Rice cultivation mainly depends on rainfall. Timely advice to predict the future crop productivity and an analysis is to be made in order to help the farmers to maximize the crop production of crops. Yield prediction is an important agricultural problem. In the past farmers used to predict their yield from previous year yield experiences. Thus, for this kind of data analytics in crop prediction, there are different techniques or algorithms, and with the help of those algorithms we can predict crop yield. Random forest algorithm is used. Using all these algorithms and with the help of inter-relation between them, there are a growing range of applications and the role of big data analytics techniques in agriculture. Since the creation of new innovative technologies and techniques The agriculture field is slowly degrading. Due to these inventions, people are concentrated on cultivating artificial products that are hybrid products, where they lead to an unhealthy life.

Keyword: *Early Risk Assessment, Prompt Action, User-Friendly Interface, Web-app*

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1. INTRODUCTION

Machine learning has reformed the manner in which we approach and tackle complex issues across different spaces. These innovations address a subset of man-made brainpower (simulated intelligence) that spotlights on empowering PCs to gain from information and work on their exhibition on unambiguous errands without being expressly customized. Basically, machine learning permits PCs to find designs, make expectations, and adjust to changing conditions by dissecting enormous datasets. The center standard behind machine learning is to prepare models utilizing verifiable information, permitting them to sum up and pursue informed choices on new, inconspicuous information. This information driven approach has tracked down applications in endless fields, from medical care and money to advertising and independent vehicles. Machine Learning advances have become fundamental in our day to day routines, driving proposal frameworks, voice partners, extortion recognition, and considerably more.

Key parts of Machine Learning advances include:

Data: Excellent information is the soul of AI. Calculations depend on immense and different datasets to learn examples and connections.

Algorithms: AI models are based on calculations that interact information, separate highlights, and pursue expectations or choices. Famous calculations incorporate choice trees, brain organizations, support vector machines, and bunching methods.

Feature Engineering: Planning and choosing important elements (factors) from the information is fundamental for model execution. Highlight designing assists in working on the model's capacity with learning and summing up.
Training: During the preparation stage, the model gains from marked information by changing its inward boundaries. Normal strategies like inclination plunge are utilized to advance model execution.

Evaluation and Validation: Models should be assessed and approved on discrete datasets to guarantee they sum up well and don't overfit (i.e., perform well just on the preparation information).

Deployment: When a model is prepared and approved, it very well may be sent to make ongoing expectations or robotize undertakings in different applications.

Agriculture is the backbone of our country. Our economy is built over the agricultural sector. If a new farmer decides to plant a crop, there may be a chance of failing to analyze the contents of the soil and if the planted crop is not suitable for the soil, he will not earn a desired yield. The process of inspecting the soil content will be proposed by our system, and it will suggest suitable crops.

The primary aim of this project is to develop a crop recommendation system to detect the soil contents (nitrogen, phosphorus, potassium, humidity, temperature, ph value, rainfall) and also to predict the crop that is to be planted in the soil. The proposed model is one of the best ways to inspect the soil content. 1)Collecting the dataset from kaggle and training the dataset using machine learning algorithms. 2)Converting them into a .sav file and this file by using the django framework.

2.LITERATURE REVIEW: TECHNIQUES AND ALGORITHM USED:

A literature survey for a Crop and Fertilizer Recommendation System typically involves reviewing existing research, publications, and studies related to the development and implementation of such systems. Below, I outline key areas and some noteworthy papers that can provide valuable insights into this field:,Kavdir and Unsalan (2010), "Crop Identification Using Artificial Neural Networks," in which they explore the use of neural networks for crop classification based on remote sensing data, Singh et al. (2019), "Crop Classification Using Remote Sensing and Machine Learning: A Review," provides a comprehensive review of various machine learning techniques for crop classification using remote sensing data, Brus et al. (2011), "A Brief Review of Soil Classification," discusses the various methods and models for soil classification, Pan et al. (2014), "A Review of Soil N Prediction Models," provides insights into different models for predicting soil nitrogen content, a crucial factor in fertilizer recommendations, Li et al. (2018), "Fertilizer Recommendation System Based on IoT for Precision Agriculture," explores the integration of Internet of Things (IoT) data for real-time fertilizer recommendations, Vashisth et al. (2019), "Fertilizer Recommendation System Using Machine Learning and IoT," presents a system that combines machine learning with IoT for dynamic fertilizer recommendations.

Kamilaris et al. (2017), "The Rise of the Internet of Things in Agriculture," discusses the role of IoT in agriculture, including data collection from sensors for crop and soil monitoring, Lobell et al. (2009), "Satellite Detection of Increasing Inequality in the World's Croplands," highlights the use of satellite data for monitoring crop conditions, Bakhshipour et al. (2014), "A Survey of Big Data architectures and machine learning algorithms in healthcare," discusses the relevance of big data architectures and machine learning in agriculture and healthcare, Mosharraf et al.

(2017), "A Decision Support System for Fertilizer Recommendation in Crop Production," discusses the importance of user-friendly interfaces in recommendation systems, Sahambi et al. (2013), "Framework for Design and Development of a Decision Support System for Precision Agriculture," explores the development of decision support systems for precision agriculture, Thenkabail et al. (2019), "Remote Sensing for Precision Agriculture in 21st Century: A Review," provides insights into the challenges and future directions in precision agriculture and remote sensing.

3. OBJECTIVES AND METHODOLOGIES

A Crop and Fertilizer Recommendation System (CFRS) is a technology-driven solution used in agriculture to provide personalized recommendations to farmers regarding the selection of crops and the optimal application of fertilizers. The primary goal of CFRS is to help farmers make data-informed decisions to improve crop yields, reduce production costs, and minimize environmental impact.
Here's a breakdown of the key components and functionalities of a typical CFRS:

3.1. Objectives of the proposed work

Develop a robust system that evaluates the suitability of different crops for a given agricultural plot or region based on historical and real-time data, including soil properties, climate conditions, and past crop performance.Design a system that recommends precise fertilizer types and application rates for selected crops, taking into account soil nutrient levels and crop nutrient requirements. Integrate diverse data sources, including soil data, weather data, remote sensing imagery, and IoT sensor data, to create a comprehensive and up-to-date dataset for analysis.Implement the Random Forest machine learning algorithm to build predictive models for crop suitability and fertilizer recommendation.Fine-tune and optimize the Random Forest model parameters to achieve accurate and reliable predictions

3.2.Development of a Predictive Model

The development of a predictive model involves a systematic process to create a mathematical or computational model that can make predictions or forecasts based on input data. Predictive models are used in various fields, including finance, healthcare, marketing, and machine learning. Here's a general outline of the steps involved in developing a predictive model:

3.2.1 Define the Problem:

Clearly articulate the problem you want to solve with the predictive model.Specify the target variable you want to predict (e.g., sales revenue, disease diagnosis, customer churn).

3.2.2 Data Collection and Preprocessing:

Gather relevant data, which may come from databases, surveys, sensors, or other sources. Clean the data by handling missing values, outliers, and inconsistencies.Explore the data through descriptive statistics and visualization to gain insights.

3.2.3 Feature Engineering:

Select and engineer relevant features (input variables) that are likely to impact the target variable. Perform transformations, scaling, or encoding of categorical variables if necessary.

3.2.4 Data Splitting:

Divide the dataset into two or more subsets: training data, validation data, and test data. The training data is used to train the model, the validation data is used for tuning hyperparameters, and the test data is reserved for evaluating the final model's performance.

3.2.5 Select a Model:

Choose an appropriate predictive modeling algorithm based on the problem type (e.g., regression, classification) and the characteristics of the data. Common algorithms include linear regression, decision trees, random forests, support vector machines, neural networks, and more.

3.2.6 Model Training:

Train the selected model using the training dataset. The model learns patterns, relationships, and parameters from the input data to make predictions.

3.3 Increasing the Accuracy of Predictions

To increase the accuracy of predictions in a crop recommendation system, a comprehensive approach is essential. Start by sourcing high-quality and diverse data on soil types, weather conditions, historical crop yields, and local farming practices, ensuring its cleanliness and reliability. Engage in feature engineering to create meaningful variables capturing crucial crop growth factors like soil pH, nutrient levels, temperature, humidity, and precipitation. Employ machine learning models such as decision trees, random forests, or neural networks, optimizing their hyperparameters and using cross-validation to minimize overfitting. Cultivate domain knowledge, collaborating with agronomists and local farmers who offer insights into regional crop preferences and farming practices. Leverage remote sensing and IoT data, such as drones and sensors, to monitor real-time crop health and environmental conditions. Incorporate weather forecasting data for short-term and long-term predictions, recognizing the significant influence of weather on crops. Employ geospatial analysis to consider specific farmland characteristics. Ensure user feedback and system iteration are part of your strategy, making your recommendation system more valuable and user-friendly. Prioritize model interpretability for trust and adoption, focus on scalability and ethical considerations, and foster collaboration with institutions and experts. Continuous learning and staying updated with advancements in machine learning and agriculture are paramount to long-term success in improving crop recommendation accuracy.

3.4 Exploring potential future opportunities

The future of crop and fertilizer recommendation systems offers promising opportunities at the intersection of technology and agriculture. Precision Agriculture will continue to flourish as Internet of Things (IoT) devices become more integrated, providing real-time data on soil conditions, crop health, and environmental factors. This will enable recommendation systems to offer dynamic and precise advice, optimizing resource usage and crop yields. Machine learning and AI advancements are expected to play a pivotal role, allowing for the analysis of complex and diverse datasets, including satellite imagery and sensor data. These advanced models will enhance the accuracy and timeliness of recommendations. Furthermore, the adoption of blockchain technology for transparent and traceable supply chains may enable farmers to make informed decisions regarding the sourcing and application of fertilizers. Additionally, advancements in robotics and automation can facilitate the efficient delivery of fertilizers based on recommendations, reducing human labor and resource wastage. Overall, the future holds tremendous potential for crop and fertilizer recommendation systems to contribute to sustainable and productive agriculture.

3.5 Insights into Learned Features

In a crop and fertilizer recommendation system, the insights gleaned from the learned features shed light on the critical factors influencing the model's decision-making process. These learned features encompass a wide array of agricultural and environmental variables. Soil characteristics, such as pH levels, nutrient content, and organic matter, emerge as vital elements, signifying their significant impact on crop and fertilizer recommendations. Weather and climate data play an equally crucial role, with the model recognizing the profound influence of temperature, precipitation, humidity, and sunlight on crop growth.Additionally, historical crop performance data underscores the importance of past successes and failures in guiding recommendations, reflecting the system's ability to leverage crop history for optimal decisions. Environmental factors, like topography and proximity to water bodies, also contribute to feature learning.

3.6 Synthetic procedure/flow diagram of the proposed work

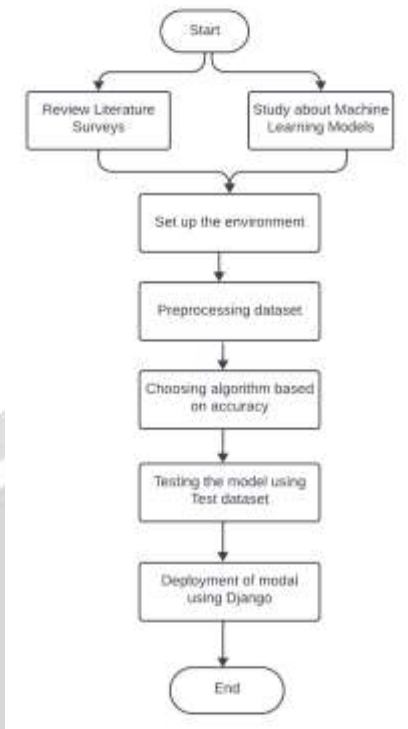

Fig:3.6.1: Flow Diagram for Proposed work

3.7 Testing the Model Using a Test Dataset

Testing the model using a test dataset is a critical step in the development and validation of a crop and fertilizer recommendation system. This process involves assessing the model's performance and its ability to make accurate predictions on unseen data. During testing, the test dataset, which is distinct from the training data used to train the model, is employed to evaluate various aspects of the system's functionality. The test dataset typically contains a representative sample of real-world scenarios, reflecting diverse soil types, weather conditions, and historical agricultural practices. The model's learned features and recommendations are put to the test against this dataset, allowing for an assessment of its predictive accuracy. Performance metrics such as accuracy, precision, recall, F1-score, and mean absolute error (MAE) are commonly used to quantify the model's effectiveness in predicting crop choices and fertilizer recommendations. These metrics provide valuable insights into how well the system aligns with real-world outcomes and whether it offers practical and reliable guidance to farmers. Furthermore, the test dataset can reveal any potential biases or shortcomings in the model's recommendations. It helps identify areas where the model may need improvement, whether in terms of specific crop choices, fertilizer dosage, or adaptability to varying environmental conditions. Ultimately, testing the model with a dedicated test dataset is a pivotal step in refining and fine-tuning the crop and fertilizer recommendation system. It ensures that the system not only leverages learned features effectively but also meets the high standards of accuracy and reliability required for practical use in agriculture.

3.8. Model Deployment Using Django

Developing a model using Django for a crop and fertilizer recommendation system involves combining the power of Django's web development framework with machine learning capabilities. To begin, you set up your Django project, configure your database, and design the database models to store essential data, including soil characteristics, weather information, historical crop performance, and fertilizer details. Next, you acquire and integrate relevant data sources into your system, utilizing Django's management commands or scripts for data import. Implementing user authentication and authorization is crucial, ensuring that your system can securely manage user accounts.
With the foundation in place, you embark on creating the user interface, which can be built using Django's

templating engine or incorporated with a front-end framework like React or Vue.js for more dynamic interactivity. To provide valuable crop and fertilizer recommendations, develop machine learning models that consider various factors, including soil types, weather conditions, historical data, and user preferences. Django then becomes the bridge between the user interface and the recommendation logic, processing user inputs, retrieving data from the database, and feeding it into the machine learning models.

4.IMPLEMENTATION AND DEVELOPMENT FOR PERSONALIZED MEDICINE APPROACH:

A Crop and Fertilizer Recommendation System(CFRS) is a technology- driven result used in husbandry to give individualized recommendations to growers regarding the selection of crops and the optimal operation of diseases. The primary thing of CFRS is to help growers make data- informed opinions to ameliorate crop yields, reduce product costs, and minimize environmental impact.

4.1.Objectives of the proposed work

Develop a robust system that evaluates the felicity of different crops for a given agrarian plot or region grounded on literal and real- time data, including soil parcels, climate conditions, and once cropperformance.Design a system that recommends precise toxin types and operation rates for named crops, taking into account soil nutrient situations and crop nutrient conditions. Integrate different data sources, including soil data, rainfall data, remote seeing imagery, and IoT detector data, to produce a comprehensive and over- to- date dataset for analysis.Implement the Random Forest machine learning algorithm to make prophetic models for crop felicity and toxin recommendation. Fine- tune and optimize the Random Forest model parameters to achieve accurate and dependable prognostications. Developing a crop recommendation and toxin recommendation system using machine literacy and Django can be a precious design, especially in the field of husbandry where data- driven decision- timber is getting decreasingly important.
Below is a high- position figure of how you can approach this design

4.2.Data Collection

Gather literal data on crop yields, soil types, rainfall conditions, and toxin operation. You can gain this data from original agrarian authorities, exploration institutions, or open data sources. Collect data on different types of diseases available in your region, their nutrient content, and their goods on different crops.

4.3. Data Preprocessing

Clean and preprocess the data to handle missing values, outliers, and inconsistencies. Perform point engineering to prize applicable information from raw data.

4.4. Machine Learning Models

Develop machine literacy models to prognosticate suitable crops grounded on factors similar as soil type, climate, and literal data. Train models for toxin recommendation grounded on soil nutrient situations, crop choice, and literal toxin operation. Common algorithms for crop recommendation include Decision Trees, Random timbers, and grade Boosting. For toxin recommendation, you might use retrogression or bracket models.

4.5. Testing the Model Using a Test Dataset

Testing the model using a test dataset is a critical step in the development and confirmation of a crop and toxin recommendation system. This process involves assessing the model's performance and its capability to make accurate prognostications on unseen data. During testing, the test dataset, which is distinct from the training data used to train the model, is employed to estimate colorful aspects of the system's functionality. The test dataset generally contains a representative sample of real- world scripts, reflecting different soil types, rainfall conditions, and literal agrarian practices. The model's learned features and recommendations are put to the test against this dataset, allowing for an assessment of its prophetic delicacy.

4.6. Model Evaluation

Split your dataset into training and testing sets to estimate the performance of your models. Use criteria like delicacy, perfection, recall, and F1- score for crop recommendation models. For toxin recommendation, you can use criteria like Mean Absolute Error(MAE) or Root Mean Square Error(RMSE).

4.7.Django Web operation

After converting the machine literacy model into a '. sav ' train using the joblib library, produce a Django web operation to make your recommendation system accessible to druggies. apply stoner authentication and authorization to insure secure access and make a stoner-friendly interface for druggies to input their data(soil type, position,etc.) and admit recommendations.Integrate the machine literacy models into your Django operation for real-time recommendations. Integrating '. sav ' train to Django for recommendations.Integrating '.sav' file to Django for recommendations.

5. CONCLUSION

The Soil Content is very important in farming, However, some issues arise, such as soil infertility, soil erosion, and so on. Despite the fact that enormous effort can be made to eliminate these issues.If the appropriate plant is not planted in the appropriate soil, the farmer will not receive the desired yield. When a farmer moves to a new area, he does not know anything about the soil characteristics in that area So, in order to learn about the characteristics of the soil, So he wants to test the soil in the area sector, after testing the soil he can use this application to get best suitable crop to plant the crop in that soil. We have created a crop recommendation system to detect the soil contents(Nitrogen, Phosphorus, Potassium, Humidity, Temperature, Ph value, Rainfall)and also to predict the crop that is to be planted in the soil. The proposed model is one of the best ways to inspect the soil content. By training this in Machine Learning

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