Name: Aayush Sharma Enrol. No.: E23CSEU0605 G6-B21

AI Project Milestone – 2

1: Crop Recommendation System Using Machine Learning.

This research focuses on improving crop selection for farmers by using machine learning (ML) algorithms to examine soil and environmental variables such as pH, N, P, K, temperature, and rain. The study analyses ML approaches such as Decision Trees, Random Forest, and XGBoost, and finds that XGBoost is the most accurate, achieving 99.31%. Data is gathered from the Kaggle website and analysed using feature extraction to improve model performance. The system's main goal is to increase agricultural productivity by delivering data-driven crop suggestions for diverse soil conditions in India. **SOURCE LINK:** **https://ijsrcseit.com/paper/CSEIT2173129.pdf**

2: Crop Recommendation System.

This research uses an Arduino-based IoT setup and machine learning models (Naïve Bayes, SVM, and K-Means) to select crops based on real-time environmental data such as soil pH, moisture, and temperature. The algorithm gives farmers top crop recommendations and collects feedback via a mobile app to improve predictions over time. With 92-96% accuracy throughout its components, this system promises to boost farming efficiency and yield in Sri Lanka by continuously self-optimizing based on collected data and user feedback. **SOURCE LINK:** **https://www.researchgate.net/publication/346627389_Crop_Recommendation_System**

3: Crop recommendation system for precision agriculture

This website focuses on precision agriculture, with the goal of recommending suitable crops after considering soil quality, weather, and geographical data. It uses a dataset with parameters such as soil type, climate, and nutrient content to train an ensemble of machine learning models, including Decision Tree,

Naive Bayes, SVM, Logistic Regression, Random Forest, and XGBoost, with Random Forest being particularly accurate. The system uses majority voting to provide reliable forecasts. Crop suggestions are highly accurate, according to performance measures, assisting farmers in picking crops that maximize production and sustainability. **SOURCE LINK:** **https://www.semanticscholar.org/paper/Crop-recommendation-system-forprecision-Pudumalar-Ramanujam/a64c8a9185d5ebed4dc7bdb1f26293d7bee82c5c**

Rhyna Jain E23CSEU0616 G6-B21

AI Project Milestone – 2

1: **Enhancing crop recommendation systems with explainable artificial intelligence: a study on agricultural decision-making**

Neural Computing and Applications (2024) 36:5695–5714
https://doi.org/10.1007/s00521-023-09391-2

ORIGINAL ARTICLE

Enhancing crop recommendation systems with explainable artificial intelligence: a study on agricultural decision-making

Mahmoud Y. Shams[1] · Samah A. Gamel[2] · Fatma M. Talaat[1,3,4]

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Crop Recommendation Systems are invaluable tools for farmers, assisting them in making informed decisions about crop selection to optimize yields. These systems leverage a wealth of data, including soil characteristics, historical crop performance, and prevailing weather patterns, to provide personalized recommendations. In response to the growing demand for transparency and interpretability in agricultural decision-making, this study introduces XAI-CROP an innovative algorithm that harnesses eXplainable artificial intelligence (XAI) principles. The fundamental objective of XAI- CROP is to empower farmers with comprehensible insights into the recommendation process, surpassing the opaque nature of conventional machine learning models. The study rigorously compares XAI-CROP with prominent machine learning models, including Gradient Boosting (GB), Decision Tree (DT), Random Forest (RF), Gaussian Naiive Bayes (GNB), and Multimodal Naiive Bayes (MNB). Performance evaluation employs three essential metrics: Mean Squared Error (MSE), Mean Absolute Error (MAE), and R-squared (R2). The empirical results unequivocally establish the superior performance of XAI-CROP. It achieves an impressively low MSE of 0.9412, indicating highly accurate crop yield predictions. Moreover, with an MAE of 0.9874, XAI-CROP consistently maintains errors below the critical threshold of 1, reinforcing its reliability. The robust R2 value of 0.94152 underscores XAI-CROP's ability to explain 94.15% of the data's variability, highlighting its interpretability and explanatory power.

SOURCE LINK: https://link.springer.com/article/10.1007/s00521-023-09391-2

2: **IOT-BASED crop recommendation system**

IOT-BASED professional crop recommendation system using a weight-based long-term memory approach

S. Kiruthika [a b], D. Karthika [b]

For the vast majority of Indians, agriculture is their main source of income, and it plays a vital role in the country's economy. The most prevalent issue Indian farmers have is that they do not choose their crops based on the requirements of the soil, which has a significant negative impact on their productivity. Precision agriculture can help solve this problem. This method considers three parameters: soil characteristics, soil types, and crop yield data collection. A suitable crop to cultivate is suggested to the farmer based on these parameters. However, India must develop and civilizes the agro industry's technological engagement and usability. Due to the inability to select acceptable features, the existing system's accuracy is low, and it takes longer to process the given climate dataset. This paper proposes a method based on IDCSO (Improved Distribution-based Chicken Swarm Optimization) with WLSTM (Weight-based Long Short-Term Memory) for crop predictions and recommendations in order to address the aforementioned issues with the help of the Internet of Things (IoT). The primary phases are pre-processing, attribute selection using the IDCSO algorithm, and crop prediction using the WLSTM method. First, climate data are collected, then crop production data. For this study, the climate data includes a number of variables responsible for the rainfall at a given location and the agricultural yield in that region. Then, preprocessing is performed to enhance the quality of the input. To provide precise prediction results with shorter execution times, the IDCSO algorithm is utilized to choose the most helpful features. The most pertinent features from the provided dataset are chosen using the optimal fitness values. The required crop predictions are then performed using the WLSTM approach. Farmers can get instant crop recommendations by entering their preferred climate and crop attributes. The experimental findings show that in terms of precision, recall, and execution time, the suggested IDCSO-WLSTM technique performs better than its forerunner.

SOURCE LINK:
https://www.sciencedirect.com/science/article/pii/S2665917423000582

3: **Crop recommendation system for precision agriculture**

Agriculture in India plays a predominant role in economy and employment. The common problem existing among the Indian farmers are they don't choose the right crop based on their soil requirements. Data mining is the practice of examining and deriving purposeful information from the data. Data mining finds its application in various fields like finance, retail, medicine, agriculture etc. Data mining in agriculture is used for analyzing the various biotic and abiotic factors. Due to this they face a serious setback in productivity. This problem of the farmers has been addressed through precision agriculture. Precision agriculture is a modern farming technique that uses research data of soil characteristics, soil types, crop yield data collection and suggests the farmers the right crop based on their site-specific parameters. This reduces the wrong choice on a crop and increase in productivity. In this paper, this problem is solved by proposing a recommendation system through an ensemble model with majority voting technique using Random tree, CHAID, K-Nearest Neighbor and Naive Bayes as learners to recommend a crop for the site specific parameters with high accuracy and efficiency.

SOURCE LINK: **https://ieeexplore.ieee.org/document/7951740/authors - authors**

Razaur Rahman E23CSEU2442 G6-B21

Research Paper 1

International Journal of Science and Research Archive
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Journal Homepage: https://ijsra.net/

(Review Article)

Check for updates

Crop recommendation system for growing best suitable crop

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International Journal of Science and Research Archive, 2024, 12(01), 2928–2936

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Abstract

Agriculture is critical to ensuring global food security and financial stability, but faces significant challenges such as climate change, resource scarcity and population growth. To address these issues, crop recommendation systems have proven to be valuable tools to help farmers decide which crops to plant. These systems aim to increase crop yields and make better use of resources. This report offers an in-depth look at these promising crops, covering their importance, opportunities, challenges and future prospects. By analyzing existing research and case studies, we hope to provide a clearer understanding of the current consensus and suggest areas for further study and development.

A crop recommendation system is essentially a decision-making tool for farmers. It helps them select the best crops to grow based on factors such as soil type, climate, available resources and market demand. These systems use data analytics, machine learning and agronomic knowledge to analyze input parameters provided by farmers and then generate personalized recommendations. Using historical data, weather forecasts, soil quality assessments and crop performance models, the system aims to increase agricultural productivity, reduce risk and increase profitability for farmers. By easily integrating into digital platforms and mobile applications, crop recommendation systems enable farmers to make informed decisions and adapt to changing environmental conditions, promoting sustainable agriculture and food security.

Keywords: Crop Recommendation; Recommendation System; Random Forest Model; Hybrid Model; Classification

1. Introduction

In the complex world of global agriculture, making the right decisions about crop growth is critical. Farmers have traditionally relied on their knowledge, experience and sometimes intuition to make these important decisions. However, as technology advances, the need for systems that are more data-driven and more accurate increases. This is where crop recommendation systems come into play. These systems help farmers decide which crops to plant based on consideration of various factors such as soil quality, climate, market demand and the farmer's own interests [1].

The development of sustainable crops involves the integration of multiple disciplines, including agriculture, informatics, data analytics, and technology suitable for remote areas. Crop recommendation systems use state-of-the-art technologies such as machine learning algorithms, geographic information systems (GIS) and remote sensing to analyze large data sets and provide customized recommendations to farmers. These recommendations aim to increase agricultural productivity, improve resource efficiency and promote sustainable agricultural practices by harnessing the power of knowledge and technology.

This report offers an in-depth analysis of crop recommendation systems and highlights their importance, opportunities, challenges and future prospects. One of the key approaches in these systems is the use of hybrid methods that combine different techniques to produce robust and effective recommendations [2]. These systems integrate data-driven

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Abstract-

The research paper focuses on a crop recommendation system that uses machine learning, particularly a Random Forest algorithm, to optimize crop selection. It integrates soil, climate, and environmental data to provide personalized recommendations to farmers, enhancing agricultural productivity. The methodology combines data analytics with expert knowledge, enabling real-time adaptability and scalability. Performance metrics highlight improvements in accuracy, customization, and user satisfaction. The system promotes sustainable agriculture by helping farmers make data-driven decisions tailored to specific conditions.

Research Paper 2

CROP RECOMMENDATION SYSTEM USING MACHINE LEARNING ALGORITHM

Submitted in partial fulfillment of the requirements for
the award of Bachelor of Engineering Degree in
Computer Science and Engineering

By

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April 2022

Abstract-

The research focuses on a crop recommendation system for South Indian states, utilizing a hybrid machine learning model. The dataset includes parameters such as soil type, rainfall, groundwater, temperature, fertilizers, and pesticides. The system applies ensemble classifiers like Random Forest and Decision Tree to recommend optimal crops, aiming to maximize yield. Key performance metrics include improved crop quality identification via ranking and cost prediction for fertilizers, offering personalized recommendations to enhance agricultural productivity.

Research Paper 3

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An Effective Approach for Crop Recommendation with Using Features of Specific Locations and Seasons and Maximize Crop Yield Production by Using Machine Learning

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Submitted: 28/12/2023 **Revised**: 05/02/2024 **Accepted**: 11/02/2024

Abstract: Crop recommendation is a crucial task for farmers to improve their productivity and profitability. However, traditional methods of crop recommendation are often based on heuristic rules or expert knowledge, which may not be accurate or adaptive to the changing environmental and market conditions. Therefore, there is a need for a data-driven approach that can leverage the available information on soil, weather, and crop to provide optimal crop suggestions for farmers. In this paper, we propose a machine-learning algorithm that can recommend suitable crops for a given location and season. The algorithm uses a supervised learning method to train a classification model on a large dataset of historical crop data from various sources. The model takes as input the soil parameters, such as pH, nitrogen, phosphorus, potassium, etc., and the weather parameters, such as temperature, rainfall, humidity, etc., and outputs the most probable crop that can be grown in that location and season[1][8][19][20]. The results show that the algorithm can achieve high accuracy and precision in recommending crops that are suitable for the given conditions.

Keywords: *Crop Prediction, Machine Learning, Deep Learning, Feature Selection, Artificial Intelligence*

1. Introduction

The selection of crops in every season is a crucial task for farmers because choosing the right crop has a very significant impact on the farmer's income, food security, and environmental sustainability. However, crop recommendation is not a simple task., it involves considering multiple factors, such as soil quality, weather conditions and crop characteristics [6][]7]. Moreover, these factors are dynamic and complex and may change from year to or even from month to month. Therefore, relying on traditional methods of crop recommendation, such as trial and error, expert advice, or rule-based idea may not be sufficient or efficient.

The Machine learning helps the computer to understand Machine learning helps the computer to understand data and make final decisions and offers a new perspective on the crop recommendation problem. Machine learning can help farmers find the optimal crop for their land by analyzing large amounts of data from different sources, such as soil sensors, weather stations, satellite images, crop databases, and market trends. It also provides timely recommendations for selecting the crop and also helps to fulfil needs and requirements. Nowadays Machine learning-based techniques have been applied to various areas of agriculture, like crop yield prediction, pest detection, weed control, irrigation management, soil mapping etc[9][10]. However, crop recommendation is still a relatively new challenge for researchers. Several issues need to be addressed, such as data availability and quality, model selection and evaluation, interpretability, scalability and robustness, and ethical and social implications[21][22]. In this paper, we try to explore how machine learning can help solve the problem of crop recommendation. After reviewing the existing literature, it has been found that crop selection is a very big challenge and needs some scope for improvement. We propose a novel machine-learning algorithm that can recommend suitable crops for any location and season, based on soil and weather parameters. We evaluated the performance of our algorithm on real-world data and compared it with existing methods of crop recommendations. This research paper aims to contribute to the advancement of machine learning in the field of agriculture and to provide a useful tool for farmers to improve their productivity and profitability. We hope that this project willinspire more research and innovation in this domain, and

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Abstract-

This research paper focuses on crop recommendation using machine learning. It utilizes datasets that include soil parameters (pH, nitrogen, etc.) and weather conditions (temperature, rainfall) to train a supervised learning model. Various machine learning algorithms, including Random Forest and Decision Trees, were evaluated. Random Forest achieved the highest accuracy of 98.18%. The model helps farmers select optimal crops based on location-specific factors, aiming to maximize yield, profitability, and sustainability while reducing environmental impact