



Crop and Fertilizer Recommendation System

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Abstract: Crop recommendation and fertilizer recommendation are key components of modern agriculture that are crucial for improving crop yield, soil fertility, and sustainability. In this study, we reviewed the existing strategies for crop and fertilizer recommendations, as well as the challenges faced in implementing these recommendations. We also examined recent advances in crop and fertilizer management techniques, including precision agriculture, integrated pest management, and soil health management. Precision agriculture involves the use of technology to optimize crop production, such as sensors and mapping tools that help farmers identify areas of the field that need more or less fertilizer or irrigation. Integrated pest management involves using multiple approaches, such as crop rotation and biological controls, to manage pests and minimize the use of pesticides. Soil health management focuses on improving soil quality through practices such as cover cropping and reduced tillage, which can lead to better crop yields and soil health over the long term. But now-a-days, food production and prediction is getting depleted due to unnatural climatic changes, which will adversely affect the economy of farmers by getting a poor yield and also help the farmers to remain less familiar in forecasting the future crops For this project we use 5 different algorithms they are XG Boost, Decision Tree, AdaBoost, Support vector machine and Random Forest Apart from these algorithms Decision Tree algorithms gives better accuracy compared to remaining algorithms.

Index Terms – Crop recommendation, Fertilizer recommendation, Machine Learning, Python, Pillow, Flask

INTRODUCTION

Agriculture has an extensive history in India. Recently, India is ranked second in the farm output worldwide. Agriculture-related industries such as forestry and fisheries contributed for 16.6% of 2009 GDP and around 50% of the total workforce. Agriculture's monetary contribution to India's GDP is decreasing. The crop yield is the significant factor contributing in agricultural monetary. The crop yield depends on multiple factors such as climatic, geographic, organic, and financial elements. It is difficult for farmers to decide when and which crops to plant because of fluctuating market prices. Citing to Wikipedia figures India's suicide rate ranges from 1.4-1.8% per 100,000 populations, over the last 10 years. Farmers are unaware of which crop to grow, and what is the right time and place to start due to uncertainty in climatic conditions. The usage of various fertilizers is also uncertain due to changes in seasonal climatic conditions and basic assets such as soil, water, and air. In this scenario, the crop yield rate is steadily declining. The solution to the problem is to provide a smart user-friendly recommender system to the farmers. The crop yield prediction is a significant problem in the agriculture sector. Every farmer tries to know crop yield and whether it meets their expectations, thereby evaluating the previous experience of the farmer on the specific crop predict the yield. Agriculture yields rely primarily on weather conditions, pests, and preparation of harvesting operations. Accurate information on crop history is critical for making decisions on agriculture risk management.

Fertilizer recommendation is an important aspect of agriculture and horticulture, aimed at providing the necessary nutrients to crops and plants for optimal growth and yield. Fertilizers are substances that contain essential nutrients, such as nitrogen, phosphorus, and potassium that are necessary for plant growth and development. However, different plants require different amounts and types of nutrients depending on the stage of growth and soil conditions. Fertilizer recommendations are based on soil testing, plant nutrient needs, and other environmental factors. Soil testing is essential in determining the nutrient content of the soil and the pH level, which helps determine the type and amount of fertilizer to apply. Plant nutrient needs are determined by the type of crop or plant being grown, and the stage of growth. Environmental factors, such as temperature and moisture, also play a role in fertilizer recommendations. Proper fertilizer recommendations can help improve crop yields, reduce nutrient loss, and protect the environment from excessive fertilizer application. It is essential to follow recommended application rates to avoid over or underapplication of fertilizers, which can lead to environmental degradation or decreased crop yields.

II. REVIEW OF LITERATURE.

[1] Manojit Chattopadhyay, Surajit Chattopadhyay, "Elucidating the role of topological pattern discovery and support vector machine in generating predictive models for Indian summer monsoon rainfall", Theoretical and Applied Climatology, pp. 1-12, July 2015, DOI: 10.1007/s00704-015-1544-5

Weather forecast is one of the most important ways to predict the weather in any country. This paper proposes a rain forecast model using Multiple Linear Regression (MLR) on the Indian database. Input data has more weather parameters and rainfall prediction more accurately. Mean Square Error (MSE), precision, correlation parameters are used to validate the proposed model. From the results, the proposed machine learning model provides much better results than other algorithms in the textbooks.

[2] Kumar Abhishek, Abhay Kumar, Rajeev Ranjan, Sarthak Kumar, "A Rainfall Prediction Model using Artificial Neural Network", 2012 IEEE Control and System Graduate Research Colloquium (ICSGRC 2012), pp. 82-87, 2012.

The multilayered artificial neural network with learning by back-propagation algorithm configuration is the most common in use, due to its ease in training. It is estimated that over 80% of all the neural network projects in development use back-propagation. In back-propagation algorithm, there are two phases in its learning cycle, one to propagate the input patterns through the network and other to adapt the output by changing the weights in the network. The back-propagation-feed forward neural network can be used in many applications such as character recognition, weather and financial prediction, face detection etc

[3] Aswin S, Geetha P and Vinayakumar R, "Deep Learning Models for the Prediction of Rainfall", International Conference on Communication and Signal Processing, April 3-5, 2018, India, pp. 0657-0661.

Rainfall is one of the major source of freshwater for all the organism around the world. Rainfall prediction model provides the information regarding various climatological variables on the amount of rainfall. In recent days, Deep Learning enabled the selflearning data labels which allows to create a data-driven model for a time series dataset. It allows to make the anomaly/change detection from the time series data and also predicts the future event's data with respect to the events occurred in the past. This paper deals with obtaining models of the rainfall precipitation by using Deep Learning Architectures (LSTM and ConvNet) and determining the better architecture with RMSE of LSTM as 2.55 and RMSE of ConvNet as 2.44 claiming that for any time series dataset, Deep Learning models will be effective and efficient for the modellers.

[4] Jain A. "Analysis of growth and instability in the area, production, yield, and price of rice in India", Journal of Social Change and Development, 2018; 2:46-66

Agriculture and its related industries are without a doubt the most important sources of income in India. Furthermore, the agriculture sector makes a significant contribution to the country's GDP (GDP). The vastness of the rural area is a gift to the country.. In any event, the harvest yield per hectare is appallingly low in comparison to international standards. This could be one of the reasons for a higher rate of self-destruction among India's periphery ranchers. As information, the client provides the region and soil type. AI computations permit for the choice of the maximum nice harvest listing or the prediction of harvest yield for a client-decided on crop. Machine Learning computations such as Support Vector Machine (SVM), Artificial Neural Network (ANN), Random Forest (RF), Multivariate Linear Regression (MLR), and K-Nearest Neighbor (KNN) are used to predict crop production. Among these, the Random Forest produced the best results, with a precision of 95%. In addition, the framework suggests the optimal time to use composts to aid increase production.

[5] Manjula E, Djodiltachoumy S, "A model for prediction of crop yield" International Journal of Computational Intelligence and Informatics, 2017 Mar; 6(4):2349-6363..

Data Mining is emerging research field in crop yield analysis. Yield prediction is a very important issue in agricultural. Any farmer is interested in knowing how much yield he is about to expect. In the past, yield prediction was performed by considering farmer's experience on particular field and crop. The yield prediction is a major issue that remains to be solved based on available data. Data mining techniques are the better choice for this purpose. Different Data Mining techniques are used and evaluated in agriculture for estimating the future year's crop production. This research proposes and implements a system to predict crop yield from previous data. This is achieved by applying association rule mining on agriculture data. This research focuses on creation of a prediction model which may be used to future prediction of crop yield. This paper presents a brief analysis of crop yield prediction using data mining technique based on association rules for the selected region i.e. district of Tamil Nadu in India. The experimental results shows that the proposed work efficiently predict the crop yield production.\

III. SYSTEM REQUIREMENTS SPECIFICATION:

Functional and non-functional requirements:

Requirement's analysis is very critical process that enables the success of a system or software project to be assessed. Requirements are generally split into two types: Functional and non-functional requirements.

Functional Requirements: These are the requirements that the end user specifically demands as basic facilities that the system should offer. All these functionalities need to be necessarily incorporated into the system as a part of the contract. These are represented or stated in the form of input to be given to the system, the operation performed and the output expected. They are basically the requirements stated by the user which one can see directly in the final product, unlike the non-functional requirements. Examples of functional requirements:

- 1) Authentication of user whenever he/she logs into the system
- 2) System shutdown in case of a cyber-attack
- 3) A verification email is sent to user whenever he/she register for the first time on some software system.

Non-functional requirements: These are basically the quality constraints that the system must satisfy according to the project contract. The priority or extent to which these factors are implemented varies from one project to other. They basically deal with issues like:

- Portability
- Security
- Maintainability
- Reliability
- Scalability
- Performance
- Reusability
- Flexibility

Software and Hardware Requirements:

□ Hardware:

Operating system	: Windows 7 or 7+
RAM	: 8 GB
Hard disc or SSD	: More than 500 GB
Processor	: Intel 3rd generation or high with 8 GB Ram

□ Software:

Software's	: Python 3.6 or high version
IDE	: PyCharm.
Framework	: Flask

SYSTEM ANALYSIS AND METHODOLOGY:

Existing System:

Where as in the case of the existing system means that what is previous system says a Manual human intervention is not that much applicable and error-prone Legacy and Conventional Data Mining Algorithms can't deal with huge volumes of data, slower and inaccurate.

Disadvantages:

1. Late process
2. Its more time
3. No accurate result

Proposed system:

Here in our proposed method we are going to predict the fertilizer with the crop recommendation. In fertilizer prediction we are going to predict which fertilizer is suitable for the farming and in crop recommendation we are going to recommend the crop name based on the environment condition. And to do this we are going to implement some machine learning algorithm mentioned in abstract section.

Advantages:

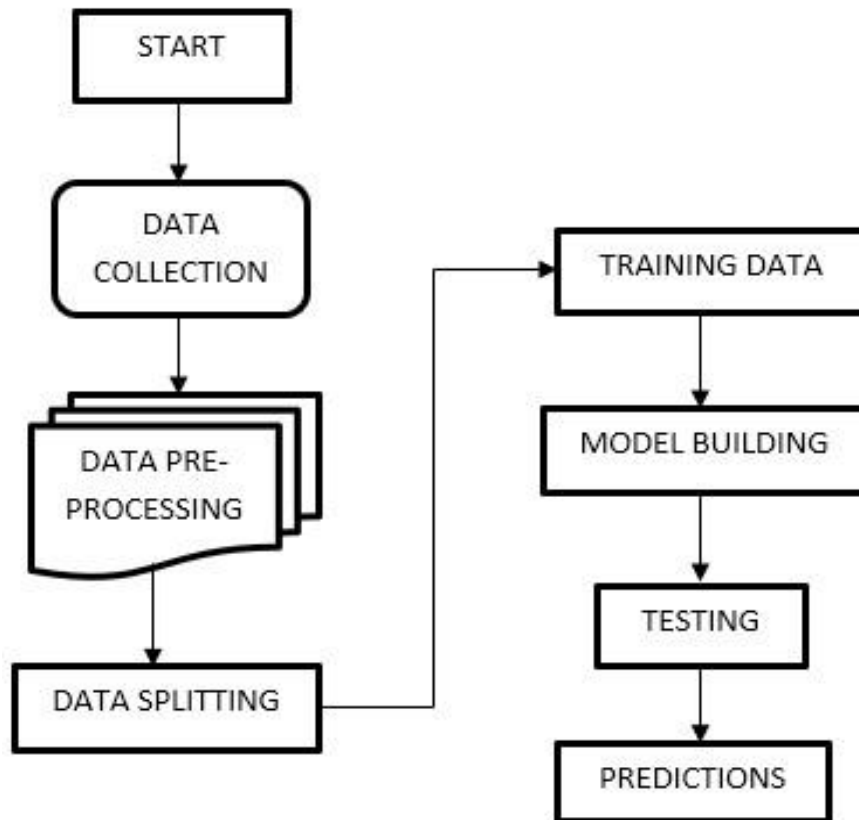
1. High accuracy
2. High reliability
3. Low complexities

Algorithms and Methodology:

1. **Decision Tree:** Decision tree is a flowchart-like tree structure where an internal node represents feature the branch represents a decision rule, and each leaf node represents the outcome. The topmost node in a decision tree is known as the root node. It learns to partition on the basis of the attribute value. It partitions the tree in recursively manner call recursive partitioning. This flowchartlike structure helps you in decision making. It's visualization like a flowchart diagram which easily mimics the human level thinking.
2. **XGBoost:** XGBoost stands for "Extreme Gradient Boosting". XGBoost is an optimized distributed gradient boosting library designed to be highly efficient, flexible and portable. It implements Machine Learning algorithms under the Gradient Boosting framework. It provides a parallel tree boosting to solve many data science problems in a fast and accurate way.
3. **Random Forest Classifier:** A random forest is a machine learning technique that's used to solve regression and classification problems. It utilizes ensemble learning, which is a technique that combines many classifiers to provide solutions to complex problems.
4. **Support Vector Machines:** The objective of the support vector machine algorithm is to find a hyper plane in an N-dimensional space (N — the number of features) that distinctly classifies the data points.

IV.IMPLEMENTATION:

The program here is implemented with the help of PyCharm IDE software, also it can be implemented using the command prompt. To perform Crop and Fertilizer Recommendation, Flask and Pillow etc., modules are used.



Step by Step Representation

V. RESULTS:

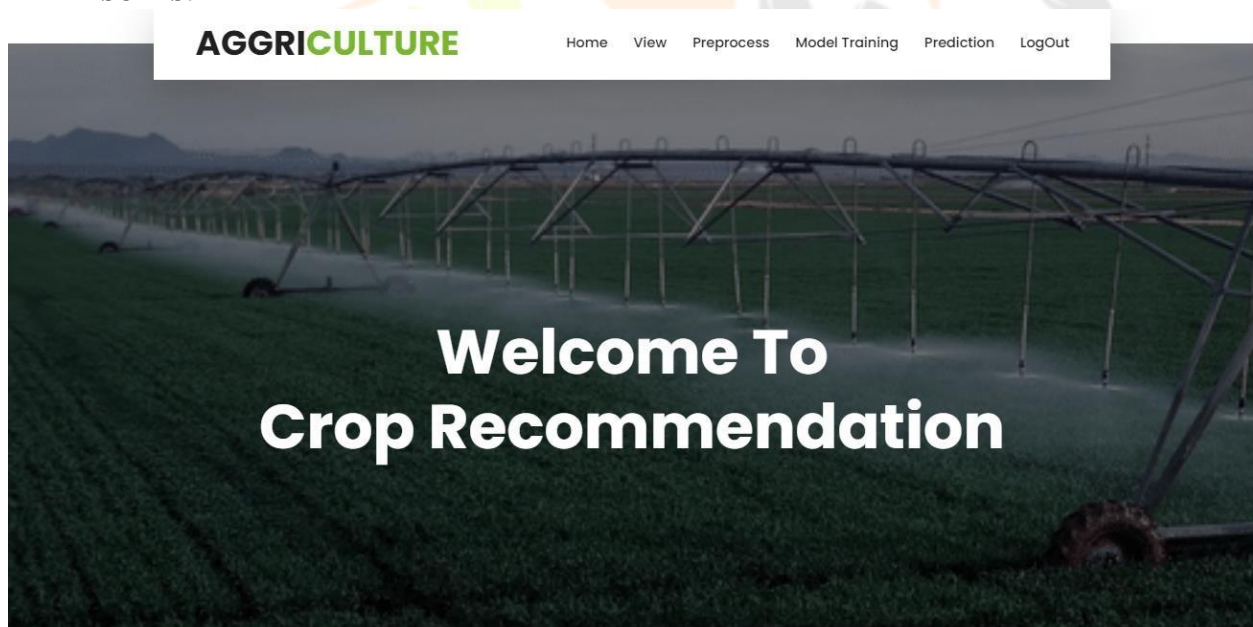


Fig1: Home Page Here user view the home page of Crop recommendation web application.

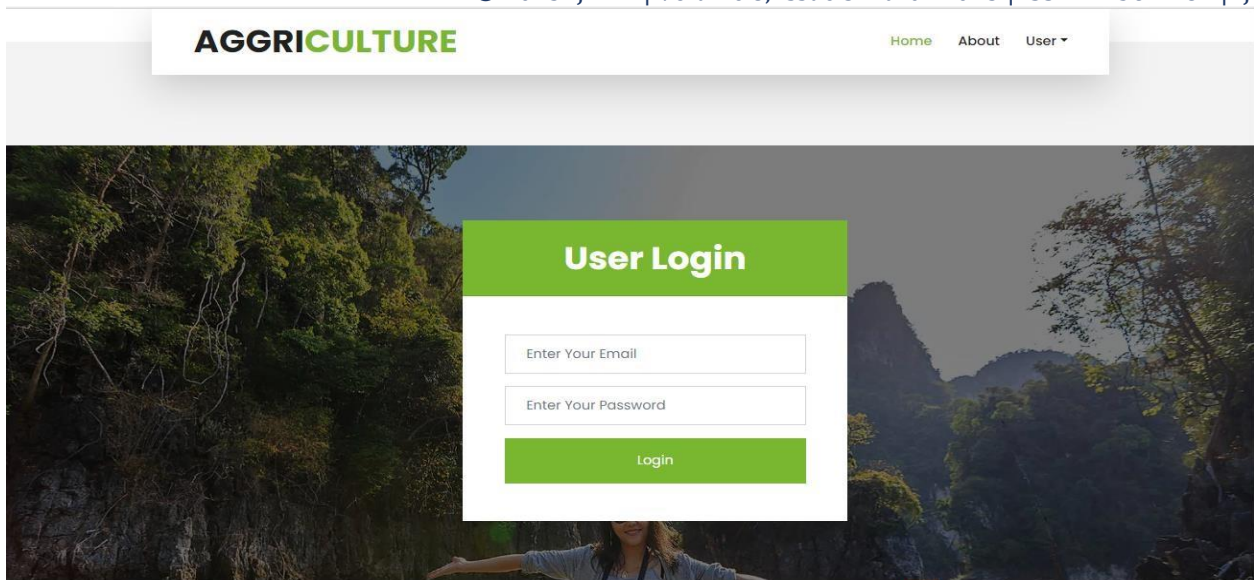


Fig3: Here the user can log in with the valid credentials.

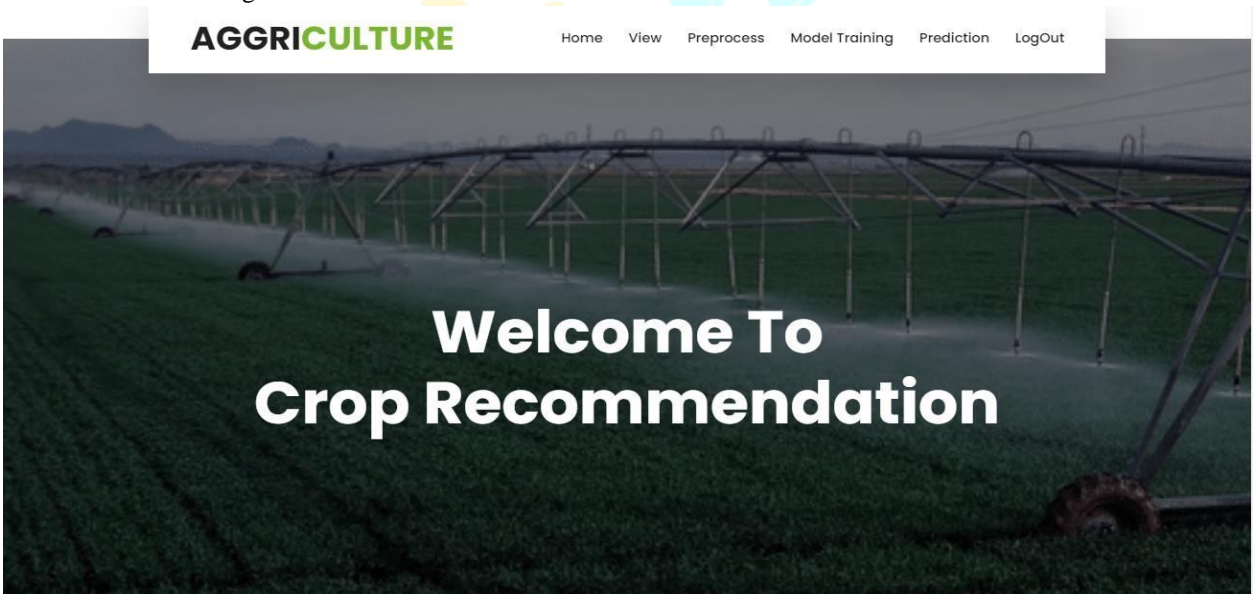


Fig4: After successful login user will enter into the user home page

Application of Machine Learning In Aggriculture							
N	P	K	temperature	humidity	ph	rainfall	label
90	42	43	20.87974371	82.00274423	6.502985292000001	202.9355362	rice
85	58	41	21.77046169	80.31964408	7.038096361	226.6555374	rice
60	55	44	23.00445915	82.3207629	7.840207144	263.96424759999996	rice
74	35	40	26.49109635	80.15836264	6.980400905	242.86403419999996	rice
78	42	42	20.13017482	81.60487287	7.628472891	262.7173405	rice
69	37	42	23.05804872	83.37011772	7.073453503	251.05499980000002	rice
69	55	38	22.70883798	82.63941394	5.70080568	271.3248604	rice

Fig5: Here we can see the uploaded data set.

Fig6: Here we can train our data using different algorithm.

Fig7: Here user enter the values in order to predict which crop is suitable based on input values

VI. CONCLUSION:

Crop recommendation and fertilizer recommendation are key components of modern agriculture that are crucial for improving crop yield, soil fertility, and sustainability. This project introduces a Digital Farming solution to help farmers to determine the best crop to sow in their fields depending on parameters such as humidity, rainfall data, moisture data, etc., values. Also determines what fertilizer is to be used if the crop was effected by any disease in order to provide maximum yield.

The main aim of Crop recommendation and Fertilizer recommendation system is to make farmers aware of modern cropping methods and infrastructure and promote precision farming.

VII. REFERENCES:

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- [3] Nadeem Ahmad, Jawaid Siddique, "Personality Assessment using Twitter Tweets", 21st International Conference on Knowledge Based and Intelligent Information and Engineering Systems, KES2017, 6-8 September 2017, Marseille, France.
- [4] Shuotian Bai a, Sha Yuana, Bibo Haoa and Tingshao Zhu , "Predicting personality traits of microblog users", Web Intelligence and Agent Systems: An International Journal 12 (2014) 249–265 249 DOI 10.3233/WIA-140295 IOS Press
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