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CROP RECOMMENDATION AND FERTILIZER PREDICTION SYSTEM USING MACHINE LEARNING

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Abstract ***In India, the farming sector has a huge impact on Indian economy. Half of the country's population is still employed in the agriculture sector. Agriculture industry is largely influenced by natural conditions of its surroundings and hence faces number of challenges in actual farming practices. Effective technology can be used to increase the yield and to reduce the maximum possible challenges in this field. Predicting the proper crop and production will aid in making better decisions, reducing losses and managing the risk of price fluctuations. Crop production assumptions made far in advance can help farmers make the necessary planning for things like storing and marketing. Agricultural industries must use machine learning algorithms to anticipate the crop from a given dataset. As a solution to the above problem, the crop recommendation system predicts the crop type that would be the most suitable crop by analyzing the environmental factors. Using KNN Algorithm Our Machine learning model will suggest the best suitable crop for particular land based on the parameters such as NPK nutrients, humidity, and temperature along with pH values are collected by the dataset and suggests the suitable crops with the help of Machine Learning algorithms. We also recommend the fertilizer (NPK Ratio) for the predicted crop.***

Keywords—K- Nearest Neighbor (KNN), Fertilizer, Machine Learning, Phosphorous, Potassium, Nitrogen.

I. INTRODUCTION

Farming and crop production has been the primary occupations of our nation since times of yore. It is reported that more than half the population of our country relies on farming, agriculture and its associated activities for their livelihood. It is also stated that almost 22% of this sector depend purely on agriculture as a main occupation. It must be noticed that dealing with plants at the ground level, allots a sizeable amount in the country's economy as well-- a share of about 16% to the Gross Domestic Product (GDP). A pivot to both the nation and the citizen, it is quite obvious that we must put in the required and necessary efforts that this sector demands. The reason for this is quite obvious since plants have innumerable uses. A source of survival (oxygen), purifying the air, vital food resources, builds the soil and much more. For the plants that give us so much, it becomes our onus and responsibility to provide them good and favorable conditions to grow, that help to increase productivity and yield, thus nourishing mankind. To meet the growing demands of food owing to the concurrent rising of the population, it is essential to resort to some means that would help increase the produce and yield.

Cultivation is among the huge occupations experienced in the nation. An enormous improvement is achieved in the nation financially by performing various farming activities. Therefore, it is referred to as the broadest money earning method. In India, 60.45% of the land is used for cultivation. It results in fulfilling the necessities of around 1.2 billion people. The process of modernizing agribusiness is vast in the present era. Hence, the farmers are moving towards advantage and achieve greater profits in less expenses. The informational indexes are analyzed with the help of Data Scientific (DA) by which the inferences about the data they contain can be reached, along with the guide of specified software and framework. Traditionally, the yield was expected on the basis of a rancher's understanding on a specific land and harvest. As the conditions are changing bit by bit, the farmers focus on building up of a regularly expanding number of harvests.

They are completely unaware of the profits they get after the cultivation. Likewise, the profitability of farm can be incremented by having a good understanding and estimation of crop execution in natural condition. In this paper, the proposed framework requires the information of the area of client. The constituents of the soil such as Nitrogen, Phosphorous and Potassium are achieved from the area. The two more datasets are contemplated in the handling part which include crop and feature datasets, taken from the website kaggle.com, have distinct information, taken as static information. The static information represents the creation of harvest and data identified about various yields obtained from different government sites. The proposed structure uses Artificial Intelligence (AI) and calculates for making expectation like Multiple Linear Regression to recognize the model among information. Further, it is processed as indicated including conditions. Thus, it will provide the best feasible reaps as demonstrated by given biological conditions. Hence, this system simply needs the area of the customer and suggest various beneficial yield. It

provides a decision to the farmer about which harvest to develop.

II. LITERATURE SURVEY

TITLE: "Agricultural Crop Recommendation System Using IoT and M.L(International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), Volume 2, Issue 1, May 2022)"AUTHORS: Prof. Swati Dhabarde1 , Swapnil Bisane2 , Akshay Gupta2 , Devyani Pote2 , Arati Yadav2

The aim of this paper is to propose an IoT and ML based Agriculture system that can assist farmers or agriculturist in crop prediction based on Metrological Agriculture theory by getting live Metrological data from the crop field using IoT technology and M.L for prediction which will enable smart farming and increase their overall yield and quality of products. This Proposed Project is based on IoT and Machine Learning. Principles of Agronomy and Agricultural Meteorology are the key concepts which are implemented for the prediction of the favourable crop. Currently for this proposal the Meteorological data of Bidar, Karnataka is taken into consideration. Many Sensors are involved for collecting various Meteorological and Edaphic Factors data. The following are the Hardware and Software requirements involved for the execution of the concept. Climate changes and rainfall has been erratic over the past decade. Due to this in recent era, climate-smart methods called as smart agriculture is adopted by many Indian farmers. Smart agriculture is an automated and directed information technology implemented with the IOT (Internet of Things). IOT is developing rapidly and widely applied in all wireless environments Decision tree Algorithm plays a vital role in prediction by making decisions at every level in the binary tree. Decision tree can be used to visually and explicitly represent decisions and decision making. It uses a tree-like model of decisions. Though a commonly used tool in data mining for deriving a strategy to reach a particular goal, it's also widely used in machine learning.

TITLE: "Crop recommendation and yield prediction using machine learning algorithms(World Journal of Advanced Research and Reviews, 2021, 14(03), 452–459)"AUTHORS: Sundari V, Anusree M, Swetha U and Divya Lakshmi R

Agriculture is the foundation of many countries' economies, particularly in India and Tamil Nadu. The young generation who are new to farming may confront the challenge of not understanding what to sow and what to reap benefit from. This is a problem that has to be addressed, and it is one that we are addressing. Predicting the proper crop and production will aid in making better decisions, reducing losses and managing the risk of price fluctuations. The existing system is not deployed, unlike ours, which is done by applying classification and regression algorithms to calculate crop type recommendations and yield predictions. Agricultural industries must use machine learning algorithms to anticipate the crop from a given dataset. The supervised machine learning technique is used to analyse a dataset in order to capture information from multiple sources, such as variable identification, uni-variate analysis, bi-variate and multi-variate analysis, missing value treatments, and so on. A comparison of machine learning algorithms was conducted in order to identify which algorithm was more accurate in predicting the best harvest. The results show that the proposed machine learning algorithm technique has the best accuracy when comparing entropy calculation, precision, Recall, F1 Score, Sensitivity, Specificity, and Entropy. We have ensured that our proposed system accomplishes its job effectively by projecting the yield of practically all types of crops grown in Tamil Nadu, relieving some of the burden from their shoulders as they enter a new business.

TITLE: Agricultural Recommendation System for Crops Using Different Machine Learning Regression Methods (IJAEIS) 12, no. 1 (2021): 1-20)
AUTHORS: Mamata Garanayak, Goutam Sahu, Sachi Nandan Mohanty, Alok Kumar Jagadev

ML is the method of finding new models from giant information sets. Numerous regressive ways like random forest, linear regression, decision tree regression, polynomial regression, and support vector regression will be used for the aim. Area and production are among the meteorological information that's made by necessary data. This paper figures out the yield recommendation of the crop by the accurate comparison of numerous machine learning ML regressions where the overall percentage improvement over several existing methods is 3.6% In the suggested approach, first, we collect the data set from the Andhra Pradesh Govt. then pre-processing and extractions of the feature phase have been done. In the pre- the processing of the data phase, we load the missing values, the appropriate data range and use the RF classifier technique to choose the area and production attribute as our final attribute for implementation. Finally, we apply various supervised machine learning regression methods to build a prototype, which comes up with the accuracy and forecast of each crop production and recommendation. The system is organized in the following phases such as a collection of information sets, preprocessing phases, selection of features, and appealing different ML regressions such as linear regression, Decision Tree (DT) regression, Random Forest, Polynomial and Support Vector Regression methods.

TITLE: "Exploiting Hierarchical Features for Crop Yield Prediction Based on 3-D Convolutional Neural Networks and Multikernel Gaussian Process(IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, VOL. 14, 2021)
AUTHORS: MengjiaQiao ,Xiaohui He , Xijie Cheng , Panle Li , Haotian Luo, Zhihui Tian, and Hengliang Guo

Accurate and timely prediction of crop yield based on remote sensing data is important for food security. However, crop growth is a complex process, which makes it quite difficult to achieve better performance. To address this problem, a novel 3-D convolutional neural multikernel network is proposed to capture hierarchical features for

predicting crop yield. First, a full 3-D convolutional neural network is constructed to maximally explore deep spatial–spectral features from multispectral images. Then, a multikernel learning (MKL) approach is proposed for fusion of intra-image deep spatial–spectral features and inter sample spatial consistency features. Specifically, we assign a group of nonlinear kernels for each feature in the MKL framework, which provides a robust way to fit features extracted from different domains. Finally, the probability distribution of prediction results is obtained by a kernel-based method.We evaluate the performance of the proposed method on China wheat yield prediction and offer detailed and systematic analyses of the performance of the proposed method. In addition, our method is compared with several competing methods. Experimental results demonstrate that the proposed method has certain advantages and can provide better prediction performance than the competitive methods.

TITLE: " Recommendation System to Maximize Crop Yield in Ramtek region using Machine Learning (International Journal of Scientific Research in Science and Technology 6, no. 1 (2019):485-489)"
AUTHORS: Guido Perboli, Stefano Musso and Mariangela Rosano

In Indian economy and employment agriculture plays major role. The most common problem faced by the Indian farmers is they do not opt crop based on the necessity of soil, as a result they face serious setback in productivity. This problem can be addressed through precision agriculture. This method takes three parameters into consideration, viz: soil characteristics, soil types and crop yield data collection based on these parameters suggesting the farmer suitable crop to be cultivated. Precision agriculture helps in reduction of non suitable crop which indeed increases productivity, apart from the following advantages like efficacy in input as well as output and better decision making for farming. This method gives solutions like proposing a recommendation system through an ensemble model with majority voting techniques using random tree, CHAID, K _ Nearest Neighbour and Naive Bayes as learner to recommend suitable crop based on soil parameters with high specific accuracy and efficiency. The classified image generated by these techniques consists of ground truth statistical data and parameters of it are weather, crop yield, state and district wise crops to predict the yield of a particular crop under particular weather condition. In our system, we use one of the most familiar ensembling technique called Majority voting technique. In the voting technique any number of base learners can be used. There has to be at least two base learners. The learners are chosen in a way that they are competent

III. EXISTING METHOD

The biggest challenge in agriculture is to increase farm production and offer it to the end-user with the best possible price and quality.

Application of machine learning techniques like Decision Tree, Supervised Machine Learning (SVM) Algorithm to agricultural data does this and suggests the best fertilizer for each individual crop.

One of the recent works Agricultural Crop Recommendation System can assist farmers by getting live Metrological data from the crop field using IoT technology and M.L

Extracting Sensor Data from the Agricultural Field Land for over a period of time is cumbersome.

Implementation of existing method consumes high cost and high maintenance for farmer.

Drawbacks of existing system

- Difficult to identify what crop type would be the most suitable for the selected area by collecting the environmental factors for plant growth.
- The existing system which recommends crop yield is either hardware-based being costly to maintain, or not user friendly to easily accessible.
- Some existing works can only predict particular crop under particular weather condition, state and district values.
- Failure of hardware(Sensor) leads to error prone results.
- Retrieval of data from various sensor and consolidate them takes lot of time
- Most of the existing works are failure to suggest the suitable fertilizer ratio for recommended crops.

IV. PROPOSED METHOD

The novelty of the proposed system is to guide the farmers to maximize the crop yield as well as suggest the most profitable crop for the specific region.

The proposed model predicts the crop yield by studying factors such as rainfall, temperature, area, season, soil type etc.

To predict the suitable crop for the land, Machine Learning algorithms such as KNN is used in the proposed system.

The proposed model also suggests the fertilizer recommendation (NPK ratio) for predicted crop.

The proposed model is compared with other Machine Learning algorithm such as Random Forest & Decision Tree and Accuracy graph are obtained from the result.

ADVANTAGES

- K-Nearest Neighbor technique provides more accuracy of prediction.
- Comparison of multiple algorithms may provide knowledge about best accuracy.
- The proposed model predicts the suitable crop for the farmer's land by analyzing the user's data with statistical dataset stored in the server.
- The data from previous years are the key elements in forecasting current performance.

- The proposed system uses recommender system to suggest the right fertilizer(NPK Ratio) for predicted crop.
- The proposed system is designed as a web application and it is user friendly system for end users.(farmer)
- Comparison of multiple algorithms may provide a knowledge about best accuracy.
- To make accuracy and efficient prediction of fertilizer ratio

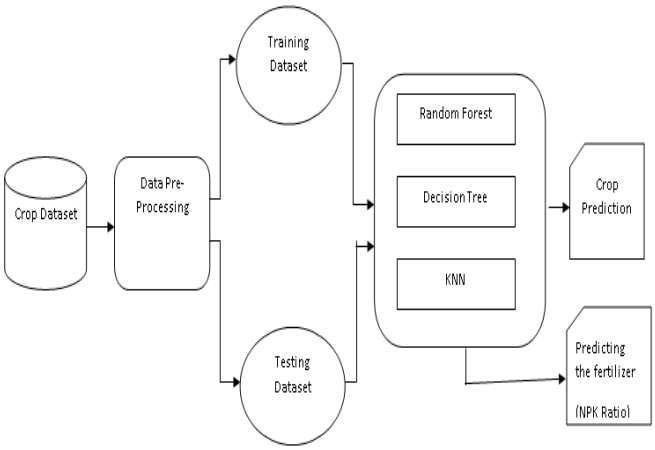

Figure 1. Architecture of Proposed system

V. EXPERIMENTAL RESULTS

Systems implementation is the process of: defining how the information system should be built (i.e., physical system design), ensuring that the information systemic operational and used, ensuring that the information system meets quality standard (i.e., quality assurance).Implementation is the process that actually yields the lowest-level system elements in the system hierarchy (system breakdown structure).

System elements are made, bought, or reused. The purpose of the implementation process is to design and create (or fabricate) a system element conforming to that element's design properties and/or requirements.

The proposed system offers several potential benefits, including increased crop yield, reduced input costs, and improved sustainability. By recommending crops and fertilizers that are better suited to the local soil and climatic conditions, the system can help farmers to optimize their yield and reduce waste.

The system is designed to be user-friendly, scalable, and cost-effective, making it suitable for use in small-scale and large-scale farming operations. It also includes a user interface that enables farmers to access the recommendations and make informed decisions about their farming practices.

MODULES DESCRIPTION

1) GATHERING AND ANALYZING DATA

The large data set has been collected from various sources on crops and their climatic and soil requirement and analyzed.
Our dataset for crop recommendation system contains more than 2000 records of NPK values with temperature, humidity and rainfall.
The datasets have been obtained from the Kaggle website.

2) DATA PRE-PROCESSING

This step is focus on identifying and using most relevant attribute from the dataset.
Through this process irrelevant and redundant information is removed for the application of classifiers.
Then they will be passed to process of feature extraction in which text data converted into numerical format of data to understand the machine before executing.

3) DATA CLUSTERING

Machine Learning algorithm are trained and tested to produced an high defined accuracy in crop selection.
We have split the dataset into 70% of data for training and 30% of data for testing data to train our machine learning model by using train_test_split() method.
The dataframe has been divided into X_train, X_test, y_train and y_test. X_train and y_train sets are used for training and fitting the model.
Where X represents the features of our dataset and y represents the class label.

4) PREDICTING THE CROP

Model fitting is a measurement of how effectively a machine learning model generalizes the data that is comparable to the data on which it was trained.
Results from a well-fitted model-KNN are more reliable.
The data are too closely matched in the dataset by KNN model is retrieved and from which the user knows the exact crop to be deployed for the current geographical status.

5) FERTILIZER RECOMMENDATION

Fertilizer recommendation can be done using fertilizer data, crop and soil data.
This Model also recommends the suitable fertilizer(NPK Ratio) for the predicted crop.

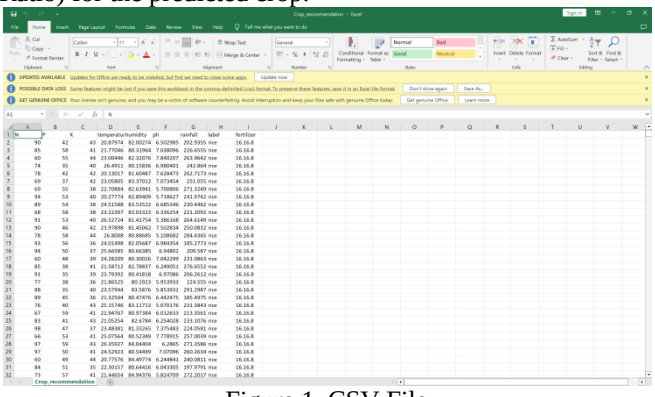

Figure 1. CSV File

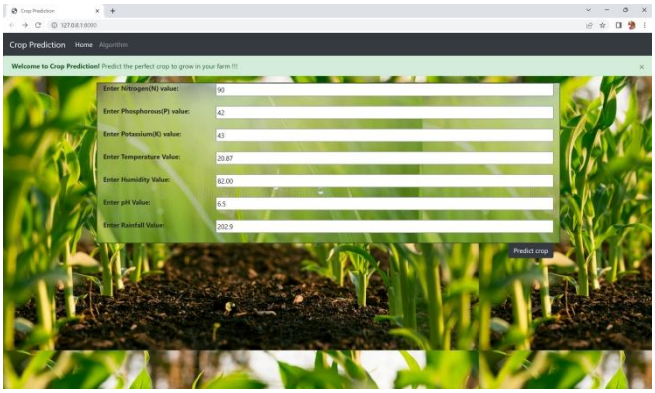

Figure 2. Input Parameters

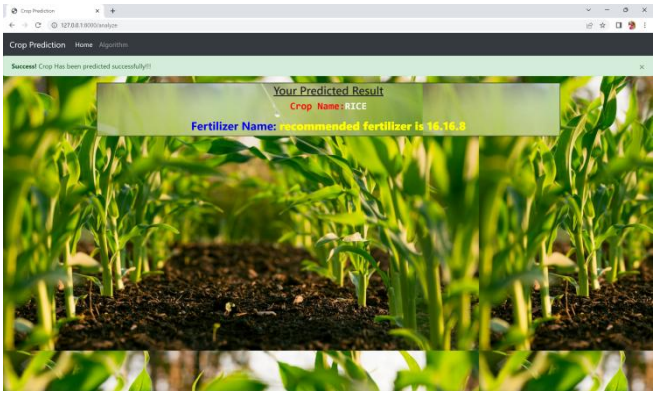

Figure 3. Crop & Fertilizer Prediction

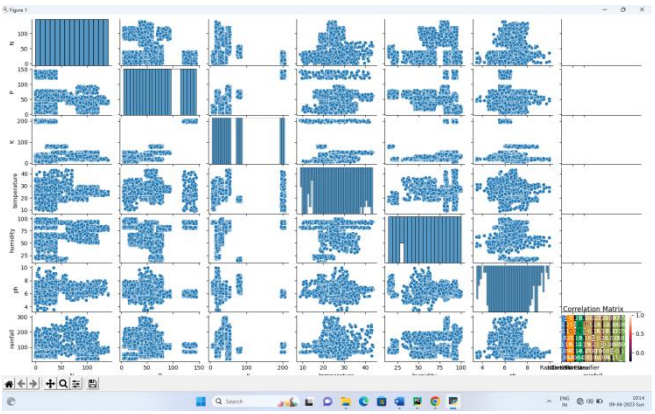

Figure 4: soil parameters variation group

MODEL	ACCURACY SCORE
Rain fall	X=Y= 0.5
Ph	X=Y= 8.16
Humidity	X=Y=81.0
Temperature	X=Y= 30.1
K	X=Y= 107
P	X=Y=104
N	X=Y=102

Figure 5: soil parameters Accuracy score value

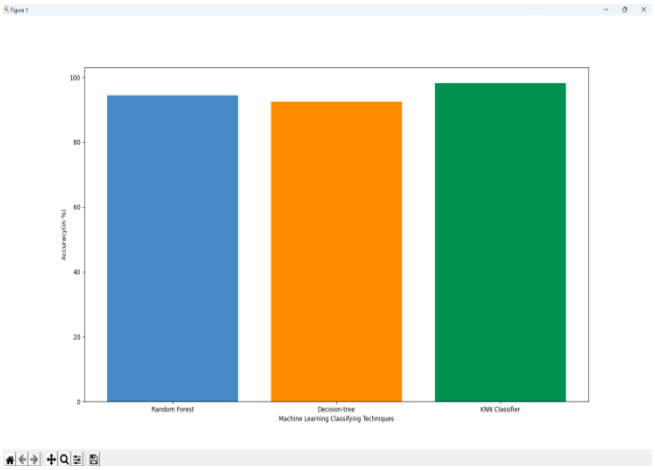

Figure 6. Comparison of Algorithm Accuracy Chart

Model	Accuracy result
Random forest	X=Y=94.5%
Decision Tree	X=Y=92.5%
KNN-Classifier	X=Y=98.5%

Figure 7. Comparison of Algorithm Accuracy

VI. CONCLUSION

The proposed model is constructed by using AI algorithms to reduce the farmers' problems of getting losses in their farms due to lack of knowledge of cultivation in different soil and weather conditions. The model is created by using K-Nearest Neighbor (KNN) technique. We also implemented some other algorithm to compare accuracy of prediction. The model predicts best crops that should be grown on land with less expenses among a number of crops available after analyzing the prediction parameters. To the best of studies, there is no such work in existence that uses the same techniques in predicting the crops. Hence, it is concluded that there is an enhancement in the accuracy of this research work when compared to the existing work that used another techniques for prediction of crops. The accuracy is calculated as 97%.

It has a vast extension in future and can be actualized and interfaced with a flexible and multi-skilled application. The farmers need to be educated and hence, will get a clear information regarding best crop yield on their mobiles. With this, even if the rancher is at home, the work can be managed at that particular instant of time, without facing any kind of loss ahead. The progress in the agribusiness field will be extremely appreciable which will further result in helping the farmers in production of crops.

A crop recommendation and Fertilizer prediction system has been developed successfully using KNN Algorithm. Our trained algorithm can predict crops based on the specified characteristics. As this system will cover the widest range of crops, farmers will be able to learn about crops. Thus, our approach can assist farmers in Tamil Nadu, particularly newcomers, in deciding which crop to produce by predicting crop and yield based on local climatic circumstances and also suggests the fertilizer (NPK ratio) for predicted crop..

FUTURE ENHANCEMENT

In future, we can try applying data independent system with new, primitive and innovative technique to implement the system more accuracy. That is whatever be the format our system should work with same accuracy. Integrating soil details to the system is an advantage, as for the selection of crops knowledge on soil is also a parameter. Proper irrigation is also a needed feature crop cultivation. In reference to rainfall can depict whether extra water availability is needed or not. This research work can be enhanced to higher level by availing it to whole India.

- The number of Android users were increasing day by day. The work can be extended further to develop a Mobile application , that can be accessed by millions of farmers across the country.
- Crop disease detection can be made using image processing techniques Machine Learning ,AI model, will identify the problems and provide them with probable solutions.

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