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E-Farming: Complete Support System for Smart Agriculture

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Abstract: **In our country, India agriculture it's the backbone of the county's monetary development. In our county, 1/3rd of the population is based directly or indirectly depending on agriculture. Agriculture plays a crucial function in human lifestyles. In our agriculture for crop prediction and yield prediction, the use of Machine Learning strategies has come to be more efficient. Yield prediction performs an important position in agriculture. Nowadays all people beginning farming should recognize simple facts about the rural place, plants to be sown, what the necessities desired for agriculture we are thinking about our historical records and related attributes which include Temperature, climatic situations, soil, and locality. For yield prediction soil additionally, plays a crucial role in farming. In this research study, we've got proposed a system to help farmers with smart farming and agriculture. We have designed the machine to crop yield prediction with the use of machine learning strategies. We are predicting the yield of two major crops grown in our county paddy and ragi and we've gathered datasets from the Mysore agriculture department. This proposed device is designed to work as actual-time software and is relevant for a couple of regions we are making use of supervised classification strategies consisting of KNN, Naïve Bayes, and Decision trees algorithm, and those anticipated results are displayed in the form of GUI.**

Index Terms: **Agriculture, Smart Farming, Machine Learning, Crops, Yield prediction, KNN. Naïve Bayes, Decision tree.**

I.INTRODUCTION

In our county, food production depends exclusively on cereals crops inclusive of paddy, ragi, jowar, rice, and so on. The growth in the population and climate changes could turn out to be an everlasting function in human existence. Farmers are facing slight difficulties with adjustments to weather situations and market payments [1]. The supply of correct and well-timed statistics such as Meteorological adjustments use of proper soil, fertilizers, and pesticides, a majority of these can assist farmers can make a choice-primarily based on plants[2].

Numerous research is carried out using ICT for supporting farmers to achieve required crop yield prediction and much research is implemented on weather circumstances [3]. To triumph over such problems, the goal of the system is to estimate or forecast agricultural yields while ensuring that all departments have timely access to reliable crop and farmer data [4]. Machine Learning can be used effectively to assist farmers in achieving the highest potential output [5]. For better yield Machine learning is best it is suitable for the bulk of data and some algorithms are efficient for results such as KNN, and Naive Bayes it works well for bulk data and small data sets [6]. The primary goal of this research is to generate a user-friendly interface to help agriculturalists cultivate the necessary crops and increase output [7]. The main purpose is to educate the general public about smart farming and the use of farming and smart technology to improve tools [8]. This will help farmers to which crops to expect and grow the vegetation in keeping with attributes and to assist anyone our important motto is to train all people about smart farming and encourage every person with internet-based learning and online dialogue discussion board [9].

II. RELATED WORK

[1] Potnuru Sai Nishant proposed crop yield prediction based on Indian agriculture using Machine Learning, in this work, the author proposes a study model for various crops in India, using Indian government datasets and taking into account several

variables such as state, district, crop, season, year, and area. Based on the results of the study, they proposed three different regression methods to effectively use crops. The three main models used to reduce the error rate are E-net, Kernel Ridge, and Stacking. ENET has a 4% system performance measure, Lassor has a 2% measure, Ridge has a 1% measure, and Stacking Regression has less than a 1%. So according to predicted yield results stacking regression technique has improved the model Further, this paper may be carried out as internet-primarily based software and this paper also states this utility may be designed for user convenient manner and application may be designed in regional language.

[2] Mr. A Suresh proposed Prediction of Major Crop yield of Tamil Nādu using K-Means and Modified K-Means, in this paper author has considered 5 major crops Ragi, Maize, Sugarcane, Rice, and Paddy are the five primary crops farmed in Tamil Nadu, and they are the five major crops identified to estimate yield rates concerning production and cultivated area in this article. They used data from 2008 year on the paper, which was obtained in the Ariyalur district.

Rainfall, groundwater, cultivation area, and soil type are some of the raw data gathering components that have an impact on agriculture parameters. Clustering is being used to convert unsupervised data to supervised data. Agriculture data are classified into clusters. Low, extremely low, medium, high, and very high data are classified. The outcome is determined using three different algorithms in this paper: K-Means, Fuzzy System, and Modified K-Means. The study provides WEKA and MATLAB to forecast the yield rate; its yielding percentage is predicted with K-Means for the MATLAB tool, and the outcomes are predicted with the Modified KNN WEKA tool. After analyzing the three alternative algorithms, the agricultural parameter method is most effective in predicting yield rates. According to the above-mentioned results, Modified KNN is the most accurate. Based on agriculture parameters like inputs such as rainfall, groundwater, and cultivated area, rice, sugarcane, maize, ragi, and Tapio are the best crops to farm with very large data sets.

[3] Shreya V Bhosale described crop yield prediction using data analytics and a hybrid approach in this study, they have predicted yield based on K means, Apriori Algorithm, and Naïve Bayes algorithm. For each algorithm, GUI and datasets are used for crop yield prediction using the tableau tool. Naïve Bayes algorithm for calculating the probability of each crop sown, apriori for the list of frequent items used and calculating their maximum support, and K means is used for clustering the crops and reducing the yield performance.

[4]Niketa Gandhi reported the Rice Crop Yield prediction in India using Support Vector Machines.

In this look, the author accumulated facts units of 27 districts in Maharashtra from the Indian Government. For this inspection, they have got taken into consideration climate parameters consisting of precipitation, temperature, crop evapotranspiration, place, and production. The datasets are accrued during the months June to November and from the year 1998 to 2002. Data Mining techniques have been carried out for sorting every record set and for classifying each data set information primarily based on yield prediction low, moderate, and high have been used. For outcomes, the evaluation WEKA tool is used for generating algorithms on current records. For performance, mean absolute error, Root Mean squared error, relative absolute errors, and root relative squared error are calculated. The experimental evaluation shows when different classifiers consisting of Naïve Bayes, Bayes Net, and Multilayer perceptron show excessive accuracy and best quality, and SMO classifiers show low accuracy and worst quality.

[5] Elucidating Farmers towards Smart Agricultural Farm Building through Cloud Model in this paper, Grajales, and others provide web software that uses a free software program to improve agriculture. Historical information units on manufacturing, land cover, and local climatic conditions are used to evaluate the analyses. Farmers can without problems combine and use the systems as a part of this method. To get facts about E-learning knowledge of strategies, a person can pick a geographical region. To create an accurate representation of the facts managed by way of the proposed gadget, we briefly describe the facts that the farmer should provide in the course of the registration phase. This approach indicates that farmers be taught thru a cloud-based e- gaining knowledge of systems.

III. PROPOSED SYSTEM

The proposed system analyses preceding rainfall, temperature, humidity, and crop yield statistics. Data from the authority's area can be used to expect crop yield (agriculture department). The proposed technique assists farmers in cultivating the relevant crop production just at the precise time, and in

increasing the yield using suggesting appropriate income. While engaging in those equal studies, temperature, rainfall, humidity, location, location, in addition to other constraints all are taken into account. Supervised learning techniques which include "Bayesian classifier" or "K Nearest" and "Naive Bayes Algorithm" have been used to make recommendations. These algorithms are well-known due to the fact they're efficient, produce faster consequences, and work with all forms of statistics. In addition, a small variety of survey courses display that these techniques are powerful and suitable for agricultural datasets.

Consider the diagram in figure 1, which provides a basic overview of crop yield prediction

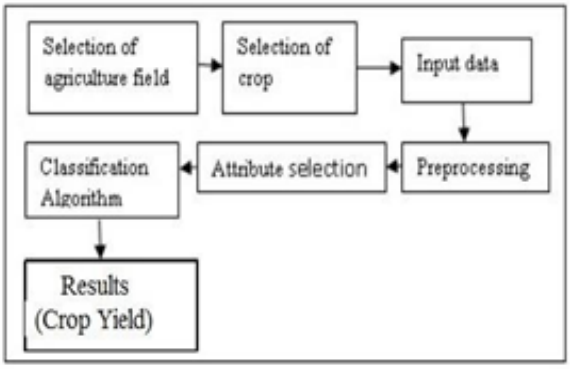

Figure 1: Overview of Crop yield prediction.

1. Agricultural field selection: Select any agricultural field for crop prediction
2. Crop selection: Consider the required crops to be planted in the field.
3. Input data: Information might include soil information (Nitrogen (N), Phosphorus(P), Potassium(K) content), Micronutrients existing in the soil, Moisture in soil, etc. which is collected over some time.
4. Pre-processing: The collected data is pre-processed as redundant data and must be inconsistent
5. Attribute Selection: You need to extract important characteristics.
6. Classification algorithm: You need to use an appropriate and efficient algorithm.
7. Results: Based on the results obtained, you can make predictions or recommendations to farmers.

IV.METHODOLOGY

A. System Architecture for E-Farming: Complete support system for Smart Agriculture

To support the proposed system a system architecture is illustrated in figure 2. Using the Crop yield prediction System architecture, we estimate the yields of two major crops, paddy, and ragi, harvested across India. For our proposed crop forecasting system, we obtained raw data from agricultural institutes in Mysore district, Karnataka. In our system, we have user requirements for an administrator who is responsible for creating staff for each agricultural department, managing staff details and uploading each detail to the database, and assigning 1 staff to each region. Staff duties include storing raw datasets, uploading datasets to a system to estimate required yield, forecasting results for two key crops, and comparing results using three types of different algorithms including Naive Bayesian, KNN, and Decision Tree for each algorithm displayed as a graph. A 3rd user of this system are users who log in and access the necessary basic information, yield prediction documents by state and region, and each training video contains basic information, and if he or she has any question, he or she can submit it in the forum.

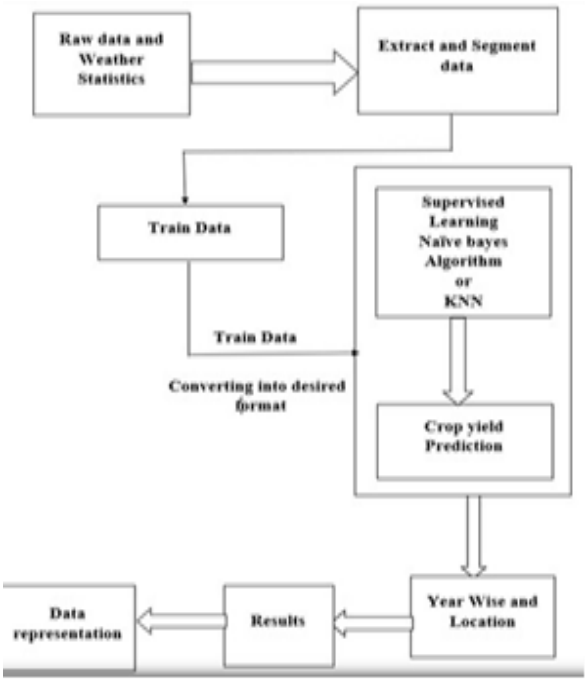

Figure 2: System Architecture for E-Farming: Complete support system for Smart Agriculture.

B. MACHINE LEARNING TECHNIQUES

Machine Learning concerns the development and examination of a system that can analyze facts. For instance, to learn how to differentiate between unwanted mail and inbox messages, for example,

machine learning can be utilized in an email message. Laptop software is stated to be discovered from revel in E with recognize to a few assignments T and a few overall performance P only if this system performance will increase with experience E. Machine Learning is a subdivision of Artificial Intelligence that includes statistical, probabilistic, and optimization strategies that may examine from beyond revel in and find out the sample from huge complex facts sets.

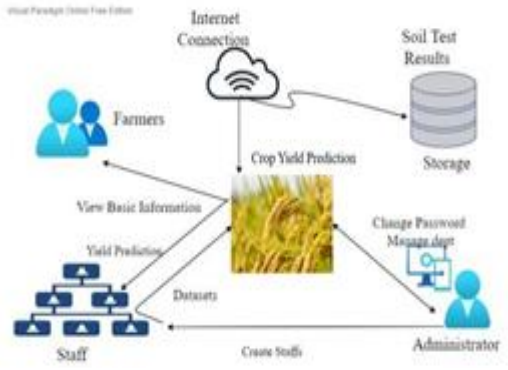

Figure 3: Methodology of the system using Machine Learning Techniques

Step 1: Raw information and Weather Statistics
This is the first step within the crop information method wherein we collect agriculture data. Agriculture statistics accrued from the locality of "Mysore" which includes agriculture parameters, crop information, farmers' information, and parameter details. Agriculture parameters include rainfall, temperature, and soil functions along with PH, nitrogen, potassium, and iron.

Step 2: Extract and Segment Data (Data Pre-processing)
Here agriculture statistics are analyzed and the simplest applicable statistics extracted. The facts required for processing are extracted and segmented according to the distinctive regions. Required facts extraction is accomplished because whole agriculture facts are now not required for processing and if we enter all statistics, it calls for too much time for processing, so facts processing is carried out.

Step 3: Train Data
Once required records are extracted and segmented, we want to train the information, educate manner changing the records into the required layout including numerical values or binary or string and so on. Conversion depends on the algorithm type.

Step 4: Supervised Learning
Machine learning focuses on devices that can analyze data and are concerned with construction.
"Naive Bayes or KNN Algorithm" is used for crop recommendation because of the subsequent reasons;

1. Efficient classifier
2. Works nice for a much smaller number of parameters in addition to a greater variety of parameters.
3. Works quality for small information-set as well as large data-set.
4. More accurate outcomes

Step 5: Crop Yield Prediction
The system predicts the yield for the selected crop based on the agriculture parameters by the use of a Machine learning algorithm.

Step 6: Location and Year Based
The crop yield prediction is accomplished primarily based on the locality wise as well as 12 months wise.

Step 7: Results
Here we discover the precision of the procedure with the aid of dividing the datasets into training and testing datasets. 80% were taken into consideration as train datasets and 20% were considered training datasets.

Step 8: Visual Representation
Crops yield is displayed for the farmers on GUI. When users get to log in the application system recommends appropriate and high-income plants for the farmers on a GUI.

C. Algorithms

1. Naïve Bayes Procedure

The Naive Bayes Method is a Machine Learning Algorithm. Initially, we are gathering information from the department of agriculture in Mysore and estimating the probability of each attribute. The steps of the naïve Bayes classification algorithm are described in the pseudo-code below

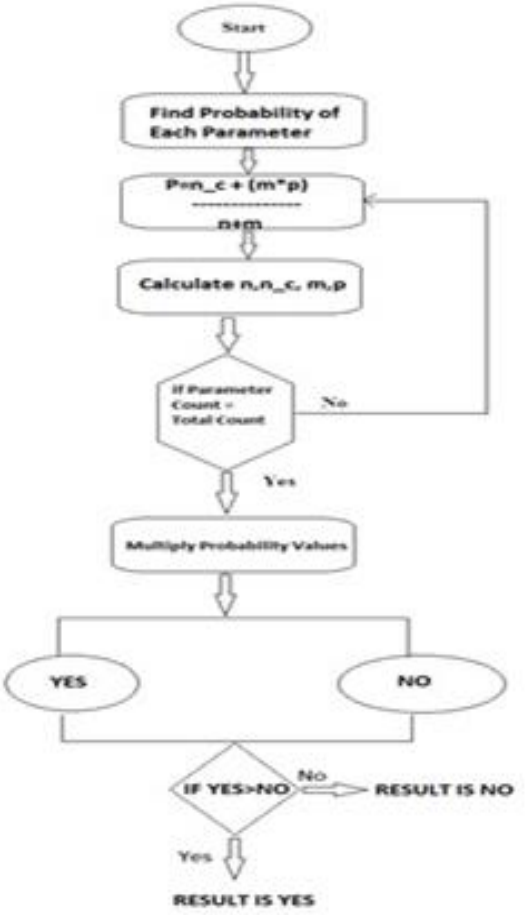

Figure 4: Flow of Naive Bayes Algorithm

2.KNN Algorithm

The K-nearest algorithm is also one of the most well-organized rulesets for numbers. It can be used for numerical information. Also, technical information is faster than other algorithms. The below pseudo-code describes the steps of the KNN algorithm.

Step 1: This works primarily based on the spatial calculation K (the number of nearest neighbours)

Step 2: Calculate the distance using the Euclidean equation

Step 3: Determine the K minimum distance in the neighbours

Step 4: Collect the nearest category y values

Step 5: Predict the value of the query instance using a simple majority of the nearest neighbour's

3. Decision Tree Algorithm

The decision tree algorithm falls below the group of supervised learning. They can be used to solve both regression and classification problems. In the beginning, we initially scan the datasets from the root, we calculate each attribute occurrence and we calculate the internal nodes occurrences based on the best yield results, and based on each attribute results are recursively recorded. Based on the best node we classify again the new node. The below pseudo-code describes the steps of the Decision Tree algorithm.

Step 1: Scan the data set (storage servers)

Step 2: for each attribute a, calculate the gain [number of occurrences]

Step 3: Let a_best be the attribute of highest gain [highest count]

Step 4: Create a decision node based on a_best – retrieval of nodes[records] where the attribute

values match with a_best.

Step 5: recur on the sub-lists [list of patients] and calculate the count of outcomes[results] –

termed as sub-nodes. Based on the highest count we classify the new node.

Step 1: Scan the dataset (storage server)

Step 2: Calculate the probability of each attribute value. [n, n_c, m, p]

Step 3: Apply the formulae

P(attribute value(ai)/subject value(vj)=(n_c + mp)/(n+m)

Where:

- n = the quantity of training examples for which v = vj
- nc = wide variety of examples for which v = vj and a = ai
- p = a priori estimate for P(aijvj)
- m = the equal sample size

Step 4: We are going to multiply the possibilities by way of p

Step 5: Compare the values and assign the characteristic value to one of the predefined sets.

5. EXPERIMENTAL RESULTS

The outputs that we can get after step-by-step execution of all the modules of the systems are defined by the subsequent snapshots

The below depicts the login module for admin, department staff, and farmers.

Figure 5: Login Page for Online Support System for Smart agriculture

The under depicts the departmental staff in which the staff can upload the data units for two fundamental crops and consider the yield prediction for two crops using 3 distinctive sets of algorithms and calculate the effects based on the accuracy.

Figure 6: Welcome page for Department Staff

Below figure 7 displays the results of yield prediction for paddy crops using the naïve Bayes algorithm. We have classified the datasets into training and testing. For accuracy, the system has considered the ratio as 80:20 and for paddy, yield prediction is 96% in which data are correctly classified and for, ragi 98% yield result is obtained and for both crops 4% and 2% incorrectly data are classified.

Figure 7: Paddy Yield Result Analysis using Naïve Bayes algorithm

The below figure 8 depicts the results of yield prediction of two different crops using 3 different algorithms. So according to GUI the best suitable algorithm for paddy yield prediction is Naive Bayes.

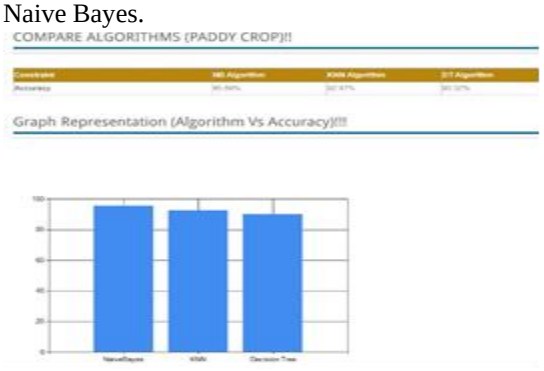

Figure 9: Graph representation for paddy (Algorithm vs Accuracy)

Below figure 10 depicts the farmer registration page.

Figure 10: Registration form for user

Below Figure 11 depicts users who log in to the system. Users can view required basic information such as required documents about smart farming, view videos, and post questions in the forum.

Figure 11: Farmer discussion online forum

6. CONCLUSION and FURTHER SCOPE

This study detailed an E-farming: Complete support system for Smart Agriculture in which we proposed two different representations for crop yield prediction and encouraged farmers to participate in e-learning. According to our findings, we predicted the yield for two major vegetations, paddy, and ragi, and evaluated by comparing the yield precision outcomes using KNN, Naive Bayes, and Decision Tree. According to the results of this study, the best suitable algorithm for crop yield prediction using machine learning techniques is Naive Bayes, and the best crop for recommendation is ragi. To encourage farming, we have also supplemented our system with E-learning and online discussion forums.

Further, this device can expect a more range of crops, this utility is a regular utility it could be utilized in multiple areas in addition we will design the system with the usage of natural language system and Artificial language the usage of textual content conversion technique and speech conversion system and help farmers increasing their income. Using hardware aid, we will layout the version by tracking the activities of the purchaser and manufacturer

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