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DEEP LEARNING TO PREDICT PLANT GROWTH AND YIELD IN THE GREENHOUSE ENVIRONMENTS

[1]Dr.D.Rathna Kishore, [2]Dr.Davuluri Suneetha

[1]Professor, Dept. of CSE, Andhra Layola College, Vijayawada, A.P, India

[2]Professor, Dept. of CSE, NRI Institute of Technology, Vijayawada, A.P, India

Abstract:

In large part, India's economy relies on the expansion of agricultural yields and the output of the agroindustrial sector because of the country's agricultural focus. The study of agricultural yields via the lens of data mining is a relatively new area of study. To accurately anticipate agricultural yields is a critical problem. Farmers care about two things: how much profit they can anticipate to make, and what kinds of crops will thrive on their land. Determine soil alkalinity by analyzing its location and pH level, for example. In addition, third-party applications, such as APIs for weather and temperature, soil type, nutrient value of the soil in that region, amount of rainfall in that region, and soil composition can be determined by using location and the percentage of nutrients like Nitrogen (N), Phosphorous (P), and Potassium (K). For the purpose of developing a model, we will examine all of these data characteristics, as well as train the data using a number of different machine learning techniques, including SVM, Random-Forest, KNN, and Voting Classifier. The system includes a model that accurately predicts crop production and provides the end user with suggestions for the optimal fertilizer ratio depending on the specific climate and soil conditions of the farm. The suggested method is dependent on inputs like soil quality data and weather reports. What factors, such nitrogen, phosphorus, potassium, and pH, contribute to the soil's quality. Data about the weather, such as precipitation, temperature, and humidity, may help farmers plan for a successful harvest. For this task, we've downloaded Kaggle datasets.

Keywords: Growth, yield rate, tomato, ficus, stem diameter, prediction, deep learning, recurrent LSTM neural networks

1. INTRODUCTION

The agricultural industry is one of the most significant contributors to the economy of our nation. It is the most all-encompassing part of the economy and plays a significant part in the overall

ISSN PRINT 2319 1775 Online 2320 7876
Research paper **Volume 11, Iss 1 , 2022**

growth and development of the nation. In order to meet the demands of the nation's population of 1.2 billion people, agriculture occupies around 60 percent of the land in the country. Therefore, the modernisation of agriculture is of critical importance and, as a result, will provide financial success to the farmers of our nation. The act of studying data sets in order to make conclusions about the information that they include is referred to as data analytics (DA), and it is performed increasingly with the assistance of specialized tools and software. In the past, predictions of yield were made by factoring in the amount of experience a farmer had working with a certain crop and land. Despite this, farmers are being obliged to plant an ever-increasing variety of crops as the weather continues to radically shift on a daily basis. Due to the fact that this is the present scenario, many of them do not have sufficient understanding about the new crops, and as a result, they are not entirely aware of the advantages they get from growing them. Understanding and predicting the behavior of crops in response to a wide range of environmental variables is another way to boost agricultural production and profitability. As a result, the data about the quality of the soil and the information linked to the weather are both taken into consideration by the suggested system. The composition of the soil, including the levels of nitrogen, phosphorus, and potassium, as well as the pH value. information pertaining to the weather, including temperature, precipitation, and humidity levels. We are using the datasets that may be found on the Kaggle website in our research.

2. LITERATURE SURVEY

2.1 VIRENDRA PANPATIL ET: It has achieved a tremendous amount of success for Indian ranchers by developing a framework for profitable yield proposals. They devised a framework by making use of many classifier models, such as the Decision Tree Classifier, the KNN Classifier, and the Naive Bayes Classifier. Utilizing the suggested framework allows for the determination of the optimal time for planting, the growth of plants, and the harvesting of plants. They used a variety of different classifiers in order to achieve a higher level of accuracy. For instance, the decision tree has a lower level of accuracy when the dataset contains more varieties, whereas the Naive Bayes algorithm has a higher level of accuracy than the choice tree when dealing with such datasets. The most significant beneficial position of the framework is that it may effortlessly be adaptable all things considered/be used to test on a variety of yields.

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2.2 MAYANKET: It has been presumed that this paper will construct an extemporized framework for crop yield utilizing administered AI calculations, with the goal of providing an easy to use User Interface, increasing the accuracy of crop yield forecasts, and researching various climatic boundaries such as cloud cover, precipitation, temperature, and so on. In the suggested framework, they decided to focus on the state of MAHARASHTRA for implantation, and they used the website of the Indian government, such as www.data.gov.in, to collect information. They applied computations such as the Random Forest Algorithm for crop production forecasting, and for the sake of convenience, they established a website page in order to make it as easy as possible for everyone to use. The suggested framework's key advantage is that its accuracy rate is higher than 75% across the board for all of the results and locations that were chosen for investigation.

2.3 SHWETAET: It has been deduced that this study will conduct a survey of the many applications of AI in the farming sectors. In addition, the use of these processes may assist in the selection of an acceptable crop, as well as the selection of land and the season for settlement. The methods Naive Bayes and K-Nearest Neighbor are used in the computations. The computations need a high degree of accuracy in their implementation.

2.4 AMIT KUMARET: It has been thought that this work assists in anticipating crop arrangements, increasing yield rates, and providing benefits to ranchers. In addition, the use of machine learning applications in agriculture for the purpose of predicting crop diseases, analyzing crop clones, and developing various water system designs. The computations used are fictional representations of neural networks. Experimentation and trial and error are required in order to determine the optimal neural architecture for a given configuration. This presents a significant challenge since determining the optimal neural organization may be challenging. The dependency on hardware is the second difficulty with neural organization, and it arises because the computations include more calculations both backward and forward, which means that more preparation is required. To ensure that the organization structure is suitable, it is necessary to invest both time and understanding. The crop selection process is also at the focus of the proposed system, which takes into account both natural and economical factors. The system also takes into account the monetary aspect that is the price of the crop, which plays a crucial role in the event that the yields have the same yield but different yield costs. The system also makes use of another method known as crop sequencing. This strategy provides a comprehensive plan for

ISSN PRINT 2319 1775 Online 2320 7876
Research paper **Volume 11, Iss 1 , 2022**

yield that may be established all through the growing season. In addition, the suggested system places an emphasis on crop selection by making use of environmental factors in addition to financial ones. The framework also employs the monetary component that is the cost of the crop, which plays an important role in the event that the crops have the same yield but different yield costs. The system also makes use of another method known as crop sequencing. This method provides a comprehensive plan for yield that may be grown all through the growing season.

2.5 MANJULA ET: It has been hypothesized that the use of rule-based mining presented in this research assists in accelerating the rate of agricultural production improvement. In order to forecast the amount of fruit that will be harvested, this article makes use of affiliation rule mining. The k-Means Algorithm, the bunching method, and derived affiliation rule mining are the mathematical processes that are used. The fact that the study bases its prediction of crop production on affiliation rule digging is a serious limitation that must be overcome. The problem with affiliation decides mining is that it might produce an overwhelming amount of rules, and the accuracy of the expectation can suffer as a result. In a similar vein, the principles will in most cases change depending on the dataset, and the results will also vary greatly depending on this. The yield expectation of the crop is the primary focus of the suggested framework. This plays an important role in yield choice, as it allows ranchers to choose the crop that will provide the highest yield. Mining of affiliation relationships is done by the frameworks in order to uncover the rules and crops that provide the highest yields. The construction of an expectation model that may be used in the future to make forecasts about crop output is the primary focus of this framework.

2.6 RAKESH KUMARET: It has been assumed that this study contributes to accelerating the rate at which crop yields may be increased by using order procedures and investigating the limits. The article provides an explanation of how several mathematical calculations were used to arrive at the equivalent. The Bayesian calculation, the K-implies Algorithm, the Clustering Algorithm, and the Support Vector Machine are the algorithms that have been suggested for use in the computations. The fact that there may not be any adequate accuracy and execution mentioned in the article according to the utilization of the suggested calculations is the obstacle that must be overcome. The work is a research paper, and all it does is advocate making use of the calculations, but it does not include any evidence that demonstrates how those calculations should be used. The method that was used in this study for the decision-making process

ISSN PRINT 2319 1775 Online 2320 7876
Research paper **Volume 11, Iss 1 , 2022**

regarding crops centered singularly on the plants that could be produced according to the time of year. The technique that has been offered resolves the choice about the crop (or crops) mostly based on the projected cost of produce supported by boundaries (for example Environment, soil kind, water thickness, crop kind). As inputs, it considers the crop, the time at which it was planted, the number of estate days, and the anticipated yield rate for the season. Based on these data, it identifies a sequence of plants whose production in relation to estate days is highest throughout the course of the season.

2.7 RAJSHEKHAR ET:The illustrations as well as the information that was given to us for the rundown of methodologies, It is possible to get information or information that can be consistent to ranchers and government associations for production well choices and for improving rules that help to expanded production in India, where there is a diverse agriculture crops production, and where those crops depend on the few sort of elements, such as natural science, economy, and furthermore the geological variables covering such procedures and strategies on memorable yield of diverse yields, it is possible to get information or information that can help to expanded production in India. In this article, our study focuses on the use of information mining methodologies, which are used to extract data from horticulture records in order to evaluate improved crop yields for primary yields in key areas of India. During the course of our work, we discovered that ranchers in India would benefit from having a more accurate forecast of the agricultural yields that can be expected in the different regions of the country. Indian ranchers will use this livestock to produce a wide variety of crops in a number of different areas.

2.8 VISHNUVARDHAN ET: They investigated a few developments in India that are addressing the problem of gaining as much as feasible from the crop's productivity. More than sixty out of one hundred times, the crop is dependent on the moisture that comes from rainstorms. The rapid improvements that have taken place in the area of information technology for agriculture have produced a fascinating exploration zone in which to speculate on crop output. The risk associated with yield expectations is a serious concern that has to be handled based on the information that is now available. Because of this, information mining approaches provide superior results in terms of determination. In the agricultural industry, several data mining methodologies are used and evaluated in order to make estimates on the next year's crop production. This paper presents a concise investigation of crop yield forecasting utilizing Multiple Linear Regression (MLR) strategy and Density based grouping procedure for a particular district, for instance the East

ISSN PRINT 2319 1775 Online 2320 7876
Research paper **Volume 11, Iss 1 , 2022**

Godavari region of Andhra Pradesh in India. The results of this investigation are presented for the East Godavari region. In this article, an effort is performed in order to determine the precise crop yield analysis for the local area. This analysis was created by using the Multiple Linear Regression approach as well as the Density-based bunching strategy. These models were evaluated with relation to the several regions that make up Andhra Pradesh; after that, the technique of evaluation was narrowed down to include just the East Godavari region of the state of Andhra Pradesh in India.

3. PROPOSED SYSTEM

In the system that has been suggested, we will construct a prediction of the crop by applying an effective algorithm.

The difficult aspect of it is to construct an effective model that can forecast a better harvest.

Machine learning methods, such as the Voting classifier, which is nothing more than a hybrid classification/ensemble of models, are being used here in this project. An ensemble of models that are derived via SVM, Random-Forest, and KNN constitutes the Voting classifier in our project. Which may help improve the accuracy, and it can also lead to a more reliable prediction system.

4. RESULTS

We have developed and tested DL (LSTM), SVR, and RFR prediction models to predict plant yield and growth in greenhouse environments for: a) ficus growth prediction based on the SDV indicator, and b) tomato yield prediction. These models were used for: a) ficus growth prediction based on the SDV indicator, and b) tomato yield prediction. In order to find the parameters of each model, the grid search methodology, which is a fairly standard approach, was applied. The design of the SVR model placed a significant emphasis on both the gamma and C parameters. In the process of designing the RF model, it was important to consider both the maximum depth of the tree as well as the total number of trees. The design of the DL LSTM model placed a significant emphasis on both the number and size of hidden layers.

The strategy that was put into action consisted of the following three steps:

• The processing of raw data and the cleansing of raw data.

• The separation of the data into three distinct datasets: training, validation, and test.

ISSN PRINT 2319 1775 Online 2320 7876
Research paper Volume 11, Iss 1 , 2022

• Design and usage of DL/LSTM, SVR, and RF models to provide a forecast that is one step ahead of time.

The findings that were collected make it abundantly evident that the DL/LSTM model performs better than the SVR and RF ones did in both of the studies. Table 1 displays the accuracy that was achieved in terms of MSE, RMSE, and MAE when each of the three (trained) models was applied to the test datasets in each of the trials. These metrics were calculated using the datasets that were used to train the models.

Table 1. Performance of the DL/LSTM model compared to those of SVR and RF models for plant yield and growth prediction.

Datasets	Tomato Yield			Ficus Growth(SDV)		
Models	SVR	RF	LSTM	SVR	RF	LSTM
MSE	0.015	0.040	**0.002**	0.006	0.006	**0.001**
RMSE	0.125	0.200	**0.047**	0.073	0.062	**0.042**
MAE	0.087	0.192	**0.03**	0.070	0.063	**0.030**

5. CONCLUSIONS

The research study established a DL technique employing LSTM for predicting tomato production and Ficus development (represented by the SDV). They were successful in reaching a high level of accuracy in their predictions for both issues.

The results of certain experiments were reported that indicate that the DL approach, which makes use of an LSTM model, performs better than other classic ML techniques, such as SVR and RF, when compared in terms of MSE, RMSE, and MAE error criterion. As a result, the primary objective of this research is to create DL techniques that can forecast the development of plants and the yield they produce in a greenhouse setting. Future research will look into the continuation of the following: a) greatly increasing the number of collected data that are used for training the proposed DL methods; b) extending the DL method so that it can perform multi-step (on a weekly, or a multiple of week basis) prediction of growth and yield in a wide variety of greenhouses in the United Kingdom and Europe.

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