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CROP YIELD PREDICTION USING DEEP LEARNING

YaramalaNeeraja, A.M.Sowjanya

Department of computer science and systems engineering, Andhra University college of Engineering (A),Visakhapatnam, Andhra Pradesh

Abstract: Agriculture is one of the vital and the least paid occupation in India. Deep learning can bring a boom in the agriculture field by changing the income scenario through growing the optimum crop. crop yield forecasting depends on many interactive factors, including crop genotype, weather, soil, and management practices. This study analyzes the performance of machine learning and deep learning methods for winter wheat yield prediction using an extensive dataset of weather, soil, and crop phenology variables in 271 counties across Germany from 1999 to 2019. We proposed a Convolutional Neural Network (CNN) model, which uses a 1-dimensional convolution operation to capture the time dependencies of environmental variables. The prediction made by machine learning algorithms will help the farmers to decide which crop to grow to get the maximum yield by considering factors like temperature, rainfall, area, Nitrogen, potassium, phosphorous etc. A central challenge is yield estimation, which is to predict crop yields before harvesting. We introduce a scalable, accurate, and inexpensive method to predict crop yields using publicly available remote sensing data. This solution if implemented at the soil health centers which have been set up by the government could help all the farmers to use minimum fertilizers, so as to maintain the soil health and also would provide them an opportunity to gain at most revenue from the same piece of land.

Index Terms- Agriculture, Artificial Neural Network, Convolution Neural Network, Crop Prediction,

1. Introduction

The history of agriculture in India dates back to the Indus Valley Civilization Era. India ranks second in this sector. Agriculture and allied sectors like forestry and fisheries account for 15.4 percent of the GDP (gross domestic product) with about 31 percent of the workforce. India ranks first globally with the highest net cropped area followed by US and China. Agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. Due to the revolution in industrialization, the economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. It is estimated that 795 million people still live without an adequate food supply (FAO 2015), and that by 2050 there will be two billion more people to feed (Dodds and Bartram 2016). Ending hunger and improving food security are primary goals in the 2030 Agenda for Sustainable Development of the United Nations (United Nations 2015). A central challenge to address food security issues is yield estimation, namely being able to predict crop yields well before harvesting. Agricultural monitoring, in particular in developing countries, can improve food production and support humanitarian efforts in light of climate change and droughts (Dodds and Bartram 2016). Existing approaches rely on survey data and other variables related to crop growth (such as weather and soil properties) to model crop yield.

2. Literature Survey

Priya et al. [1] Predicting yield of the crop using machine learning algorithm. The agriculture plays a dominant role in the growth of the country's economy. Climate and other environmental changes has become a major threat in the agriculture field. Machine learning (ML) is an essential approach for achieving practical and effective solutions for this problem. Crop yield Prediction involves predicting yield of the crop from available historical available data like weather parameter soil parameter and historic crop yield. This paper focus on predicting the yield of the crop based on the existing data by using Random Forest algorithm. Real data of Tamilnadu were used for building the models and the models were tested with samples. The prediction will helps to the farmer to predict the yield of the crop before cultivating onto the agriculture field. To predict the crop yield in future accurately Random Forest, amost powerful and popular supervised machine learning algorithm is used.

Mishra et al. [2] Applications of machine learning techniques in agricultural crop production: a review. This paper has been prepared as an effort to reassess the research studies on the relevance of machine learning techniques in the domain of agricultural crop production. Methods/Statistical Analysis: This method is a new approach for production of agricultural crop management. Accurate and timely forecasts of crop production are necessary for important policy decisions like import-export, pricing marketing distribution etc. which are issued by the directorate of economics and statistics. However one has understand that these prior estimates are not the objective estimates as these estimate requires lots of descriptive assessment based on many different qualitative factors. Hence there is a requirement to develop statistically sound objective prediction of crop production That development in computing and information storage has provided large amount of data. Findings: The problem has been to intricate knowledge from this raw data, this has lead to the development of new approach and techniques such as machine learning that can be used to unite the knowledge of the data with crop yield evaluation. This research has been intended to evaluate these innovative techniques such that significant Relationship can be found by their applications to the various variables present in the data base. Application/Improvement: The few techniques like artificial neural networks, Information Fuzzy Network, Decision Tree,

Regression Analysis, Bayesian belief network. Time series analysis, Markov chain model, k-means clustering, k nearest neighbor, and support vector machine are applied in the domain of agriculture were presented.

Manjula et al. [3] A model for prediction of crop yield**.** 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 absolved based on available data. Dataminingtechniquesarethebetterchoiceforthispurpose.DifferentDataMiningtechniques 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

Dhahikar et al. [4] Agricultural crop yield prediction using artificial neural network approach. By considering various situations of climatologically phenomena affecting local weather conditions in various parts of the world.These weather conditions have a direct effect on cropyield.Various researches have been done exploring the connections between large-scale climatologically phenomena and crop yield. Artificial neural networks have been demonstrated to be powerful tools for modeling and prediction, to increase their effectiveness. Crop prediction methodology is used to predict the suitable crop by sensing various parameter of soil and also parameter related to atmosphere. Parameters like type of soil, PH, nitrogen, phosphate, potassium, organic carbon

calcium, magnesium, sulphur, manganese, copper, iron, depth, temperature, rainfall, humidity. For that purpose we are used artificial neural network (ANN).

GonzlezSnchez et al. [5] Predictive ability of machine learning methods for massive crop yield predictionAn important issue for agricultural planning purposes is the accurate yield estimation for the numerous crops involved in the planning. Machine learning (ML) is an essential approach for achieving practical and effective solutions for this problem. Many comparisons of ML methods for yield prediction have been made, seeking for the most accurate technique. Generally, the number of evaluated crops and techniques is too low and does not provide enough information for agricultural planning purposes. This paper compares the predictive accuracy of ML and linear regression techniques for crop yield prediction in ten crop datasets. Multiple linear regression, M5-Prime regression trees, perceptron multilayer neural networks, support vector regression and k-nearest neighbor methods were ranked.
Four accuracy metrics were used to validate the models: the root mean square error (RMS), root relative square error (RRSE), normalized mean absolute error (MAE), and correlation factor (R). Real data of an irrigation zone of Mexico were used for building the models. Models were tested with samples of two consecutive years. The results show that M5- Prime and k-nearest neighbor techniques obtain the lowest average RMSE errors (5.14 and 4.91), the lowest RRSE errors (79.46% and 79.78%), the lowest average MAE errors (18.12% and 19.42%), and the highest average correlation factors (0.41 and 0.42).

FAO et al.[6] The state of food insecurity in the world. Meeting the 2015 international hunger targets.About 795 million people are undernourished globally, down 167 million over the last decade, and 216 million less than in 1990–92. The decline is more pronounced in developing regions, despite significant population growth. In recent years, progress has been hindered by slower and less inclusive economic growth as well as political instability in some developing regions, such as Central Africa and western Asia. The year 2015 marks the end of the monitoring period for the Millennium Development Goal targets. For the developing regions as a whole, the share of undernourished people in the total population has decreased from 23.3 percent in 1990–92 to 12.9 per cent. Some regions, such as Latin America, the east and southeastern regions of Asia, the Caucasus and Central Asia, and the northern and western regions of Africa have made fast progress. Progress was also recorded in southern Asia, Oceania, the Caribbean and southern and eastern Africa, but at too slow a pace to reach the MDG 1c target of halving the proportion of the chronically undernourished

A total of 72 developing countries out of 129, or more than half the countries monitored, have reached the MDG 1c hunger target. Most enjoyed stable political conditions and economic growth, often accompanied by social protection policies targeted at vulnerable population groups.

3. Methodology

This paper focuses on the practical application of machine learning algorithms and its quantification. The work presented

Here also takes into account the in consistent data Nitrogen and Potassium and phosphorous from rainfall and temperature datasets to get a consistent trend. Crop yield prediction is determined by considering all the features in contrast with the usual trend of determining the prediction considering one feature at a time. Understanding algorithm and knowing it's turn of simulation processes that is being run in every machine learning operations. The main aim of the research is to find the correlation between the independent attributes and the yield scarcity. The two major course of sequence in ML are classification and regression which in other words can be described as generating discrete and continuous value. In the work of making assumption of a quantitative amount will require the regression function to take effect and also if classification are worked with then the model should beevaluated with preferred kernel function. Initially, a set of dataset is collected with affecting parameters to differentiate the yieldinformation. Then, the whole process is run twice, including one to be the training iteration and the second to be the test iterations. The sets are split into two sides, one of which is training set and the other is testing set. The training iteration will perform a loop throughout the data and make sufficient changes in learning with the help of algorithms organization and set of conditions initiated. Error = 1 n Xn j=1 (yj − yi) 2

1. Data Pre-Processing

- It is a method that is used to convert the raw data into a clean data set.
- The data are gathered from different sources, it is collected in raw format which is not feasible for the analysis.
- By replacing missing values and null values we can transform data into an understandable format.
- The final step is splitting of training and testing data.

2. Factors affecting crop yield and production

- There are a lot of factors that affects the yield of any crop and is production
- Features that help in predicting the production of any crop over the year.
- Nitrogen,pottasium,phosphorous,PHandRainfal

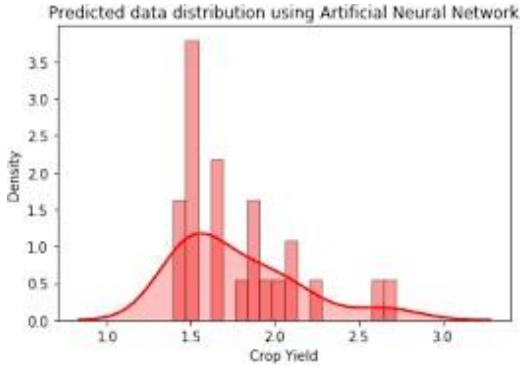
Modules

- Upload Agriculture Dataset & Load dataset
- Preprocess Dataset
- Train Dataset X,Y
- Accuracy Comparison Graph
- Predict Crop Using Test Data

Multilayer Perceptron (MLP)

MLPs belong to the class of feed forward neural networks with multiple layers of perceptrons that have activation functions. MLPs consist of an input layer and an output layer that are fully connected. They have the same number of input and output layers but may have multiple hidden layers and can be used to build speech-recognition, image-recognition, and machine-translation software.

The training process follows a series of data organization from a sequence of scattered informations. The data needs to process through every it's subsequent flaws that needs to be fix and prioritized. This follows to a step in making the data fit to a line and initiating proper value, coefficient and intercept are used in order to make the hyperplane fit to the data points in a manner to reduce loss of accuracy. The model has been specified with linear, non-linear and kernel functions. Data outliers are crucial in this step where different histogram and charts are observed for making the information easier to work and learn. The trigger of classifiers from information of data provided to pre-trained classified cases is a general problem in machine learning. The missing values can be changed to average of the set depending on the duration of the information taken i.e. monthly data or can be changed with interpolation techniques



4. Results and Evolution Metrics

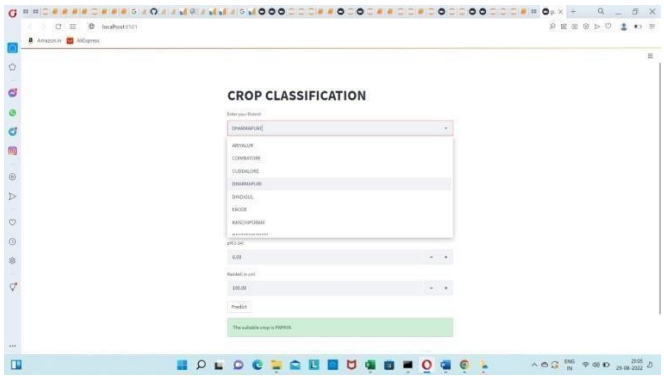


Fig 1: Main Screen

The main GUI module contains the above shown modules. In above screen start from select the district.

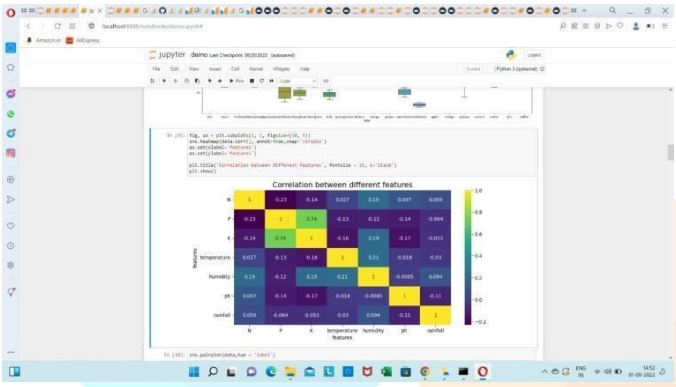


Fig 2: Correlation between different features

In the above fig shown correlation between different features based on crop trained data set.

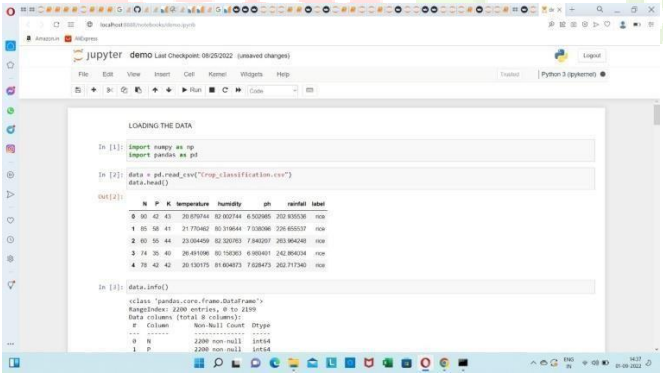


Fig 3: Extracted features from Dataset

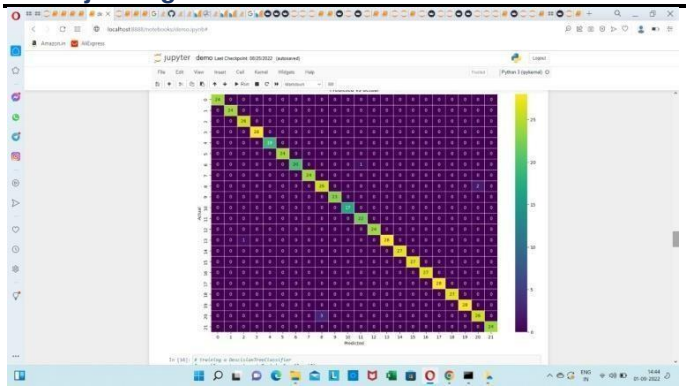


Fig 4: Predicted Graph

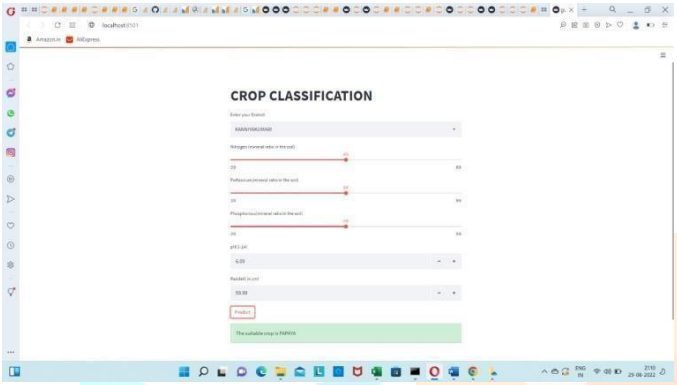


Fig 5: Predicted Output

5. Conclusion

The paper presented the various machine learning algorithms for predicting the yield of the crop on the basis of nitrogen, potassium, phosphorous, temperature, rainfall, season and area. Experiments were conducted on Indian government dataset and it has been established that Random Forest Regressor gives the highest yield prediction accuracy. Sequential model that is Simple Recurrent Neural Network performs better on rainfall prediction while LSTM is good for temperature prediction. By combining rainfall, temperature along with other parameters like season and area, yield prediction for a certain district can be made. Results reveals that Random Forest is the best classifier when all parameters are combined. This will not only help farmers in choosing the right crop to grow in the next season but also bridge the gap between technology and the agriculture sector. which might inspire other applications in remote sensing and computational sustainability. The model provides us with the state-of-the-art prediction accuracy and will have great impact in sustainable agriculture and food security.

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