IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Analysis of Crop Yield Prediction's Precision value using Deep Neural Networks with environmental change impact and uncertainty handling

Dr.M.Saranya*, Dr.T.Parimalam**

Dr.M.Saranya*, Assistant Professor, Department of Computer Science, Nandha Arts and Science College, Erode, Bharathiar University. TamilNadu, India.

Dr.T.Parimalam, HoD, Department of Computer Science, Nandha Arts and Science College, Erode, Bharathiar University. TamilNadu, India.

ABSTRACT

In the earliest days, day to day routine works like message communication, business transactions, recording of achievements, searching the miracle things, crop yields, etc., were done only through manual. So, updating data takes more time. But in the current era, everything is happening with in the fraction of second via internet. Agriculture is more important to increase the one country's economical growth. Most importantly, the new innovations in crop yield prediction are expected by all human beings. Many technologies are available to promote the yield prediction with-in a short period. So this paper, analyze all the results in the deep neural network models for crop yield prediction. The effectiveness of the proposed "Analysis of Crop Yield Prediction's Precision value using Deep Neural Network with environmental change impact and uncertainty handling" is analyzed in terms of Precision.

Keywords- Deep Neural Network, Crop Yield Prediction, Precision, Feature Extraction**.**

I. INTRODUCTION

Agriculture is the principal route of income for all over the countries. It helps to improve the state's economy as it has many farmers. Thus the national rate of wages as well as the lives of citizens was also strengthened. Agricultural analysis is referred to as agricultural science. The past of agriculture extends back several thousand years and its development has been guided and characterized by a vast variety of diverse atmospheres, civilizations and innovations such as modern farming according to widespread monoculture. It is the main demographic economy segment and plays a crucial role in India's entire socio-economic structure [1]. India is the top manufacturer of seed, corn, wheat, spices and pepper worldwide.

Crop yield prediction [2] is the main role of forecasting yield and profitability, usually several months before harvest in advance. It is typically the product of complicated interactions between different features of adopted land,

temperature, seed genotype, management practices and etc., There are many challenges that affects crop yields [3] like quality of straw, grains, chemical compositions, drought flood and salinity tolerance, early maturity, diseases and pest. And also Precipitation, Temperature, Humidity, Solar radiation, Soil moisture, Soil air, Soil Temperature, Soil mineral matter, Soil reaction, Topography, Steepness of slope are some more factors that affects the crop yields.

Deep learning [4] is the extended version of classical machine learning which adds more depth or complexity to the model, transforms the data using various functions and allows data representation in a hierarchical way through several levels of abstraction. A major advantage of deep learning technique is feature learning i.e. the automatic feature extraction from raw data with features from higher levels of the hierarchy being formed by the composition of lower level features.

II. LITERATURE REVIEW

A crop yield prediction method [5] was suggested by using Optimal Neural Network (ONN) classifier in spatial data mining. The pre-processing step was used to generate a better model and a Multi-linear Principal Component Analysis (MPCA) was employed for feature selection process. Finally, ONN classifier was applied for crop yield prediction but the prediction accuracy could not be efficiently analyzed.

A model for crop yield prediction from previous data [6] predicted crop yield by using association rule mining on agricultural data. The main intention of this model was to create a prediction model for future prediction of crop yield. The pre-processed data was clustered by using K-means clustering algorithm and then association rule mining was processed on the clustered data to find the rules. However, k value of k-means clustering had greatly influenced the computation time of this model.

A yield prediction based on feature selection technique [7] was proposed by using boruta algorithm. It was developed as a wrapper around a random forest classification to choose the most discriminative features for crop yield prediction. Even though the features were selected and given as input to Multiple Linear Regression (MLR) for crop yield prediction efficiently, the prediction accuracy remained less.

Agricultural crop yield prediction [8] method was proposed based on Artificial Neural Network (ANN) approach. This method analyzed various regional soil parameters such as magnesium, types of soil, temperature level, rainfall, pH, organic carbon, humidity, sulphur, temperature level, soil depth, potassium, nitrogen, magnesium, and copper using feed forward back propagation ANN. It predicted suitable crop by analyzing various soil parameters and other parameters related with environment. However, the accuracy of prediction was not analyzed.

Agriculture crop production system [9] was suggested based on the meteorological information. This system was used for soil, crop and fertilizer prediction by processing the weather data. Different weather data such as humidity, rainfall, temperature and sunshine were collected for each location entered by the user and two types of prediction model such as naive bayes and fuzzy naive bayes were used for predicting the suitable crop for that location. However, the performance efficiency of this system was less.

Deep Neural Network (DNN) [10] was introduced to understand the environmental factor i.e. weather data for accurate yield prediction. DNN belongs to the class of representation of learning models to find the underlying representation of agriculture data without handcrafted input of features. By increasing the number of layers, more features were extracted and it aided to obtain high crop yield prediction accuracy.

Multi-Model Ensemble with DNN (MME-DNN) [11] is introduced where climate, weather and soil data are considered for yield prediction. A statistical model is used to find the variation of climate, weather and soil parameters from year-to-year to predict climate, weather and soil conditions and it plays an important role in yield prediction. The MME-DNN is not scalable

when new data appeared consecutively in a stream form.

Multi-Model Ensemble Depth Adaptive Deep Neural Network (MME-DADNN) [12] is proposed to adaptively decide the depth of the network to predict crop yield. A training scheme for OL is designed through a hedge back propagation. It automatically decides the depth of the DNN using Online Gradient Descent (OGD) in an online manner. Also, a smoothing parameter is introduced in OL to set a minimum weight for every depth of DNN and it also contributes a balance between exploitation and exploration. The multinomial LR is more sensitive to outliers. This can lead to minor degradation in crop yield prediction accuracy.

Support Vector Regression (SVR) is used instead of LR to improve the crop yield prediction accuracy. The SVR tries to maximize the margin between the closest support vectors while LR uses the posterior class probability. Thus, SVR finds a solution which is as far as possible for the two categories while LR does not have this property. This whole process is named as Multi-Model Ensemble- Enhanced Depth Adaptive Deep Neural Network (MME-EDADNN) [13]. Hence by using SVR along with DNN, the crop yield prediction accuracy is improved.

The uncertainty arises because of climatic and weather conditions and spatial variability of soil properties. It affects the crop yield prediction accuracy. In order to avoid this problem, and MME-EDADNN with Uncertainty Handling (MME-EDADNN-UH) [14] is proposed in this phase of the research work to handle the uncertainty in data. Initially, a marginal distribution between the uncertainty parameters and crop yield is calculated based on copula-based probabilistic model. It is given as input along with the climate, weather and soil parameters to the MME-EDADNN-UH for crop yield prediction. In the hidden layer of MME-EDADNN-UH, a joint probability distribution between the uncertainty parameters and the crop yield is calculated using Markov Chain Monte Carlo (MCMC) technique. Simultaneously the climate, weather and soil parameters are analyzed in the hidden layer. The output of the hidden layer is given as input to SVR for crop yield prediction. By analyzing the climate, weather and soil parameters along with uncertainty measure, the crop yield prediction accuracy of MME-EDADNN-UH gets improved.

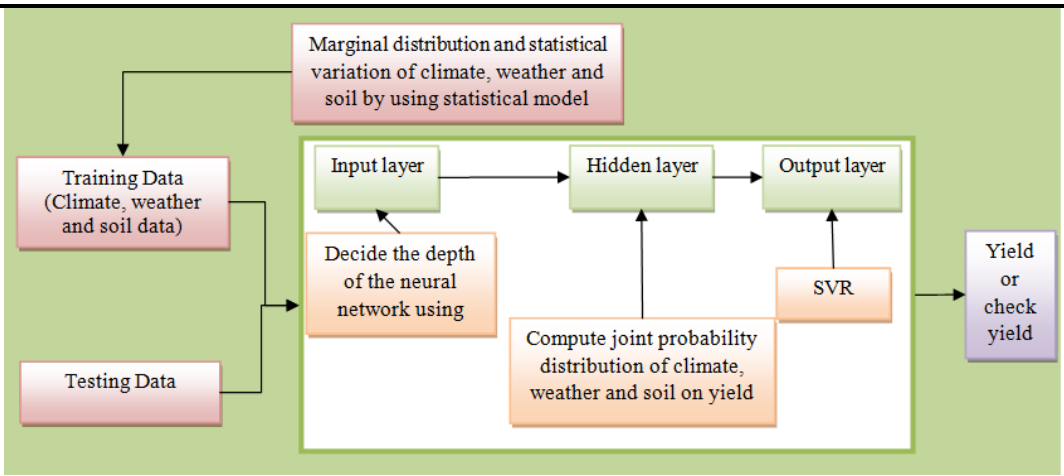
The Multi-Model Ensemble Modified Depth Adaptive Deep Neural Network (MME-DADNN) [15] is compared with MME-EDADNN by applying ridge regression method instead of SVR. Ridge regression, minimize the sum of squared residuals but also penalize the size of parameter estimates, in order to shrink them towards zero.

III. RESEARCH OBJECTIVE

The main objective of this research is to analyze the above mentioned MME-DNN, MME-DADNN, MME-EDADNN, MME-EDADNN-UH results. The research work started with climate, weather and soil parameter for the crops Banana, Groundnut, Wheat, Sugarcane and Maize in terms of Accuracy, Precision, Recall and F-Measure.

DATASET

For the experimental purpose, the climate data are collected from http://www.ccafs-climate.org/climatewizard/, crop data from https://data. World/thatzprem/agriculture-india, and soil data from https://data.gov.in/search/site?Query= soil. From the collected data, 70,000 data are used for training and 30,000 data have been used for testing. For crop yield prediction, three different classes such as low, medium and high are identified. The classification accuracy is evaluated by comparing actual and predicted class labels of the test dataset. The work flow of this research work is depicted in the Figure 1.



RESULT ANALYSIS

The Table 1 shows all the results in terms of Accuracy, Precision, Recall and F-Measure.

Crop Yield Prediction Method	Comparison of Accuracy					Comparison of Precision					Comparison of Recall					Comparison of F-measure				
	Ban	Gro	Wh	Sug	Mai	Ban	Gro	Wh	Sug	Mai	Ban	Gro	Wh	Sug	Mai	Ban	Gro	Wh	Sug	Mai
DNN	0.88	0.91	0.89	0.88	0.88	0.51	0.91	0.85	0.78	0.57	0.89	0.90	0.91	0.90	0.90	0.78	0.91	0.88	0.86	0.80
MME-DNN	0.90	0.92	0.90	0.91	0.90	0.56	0.92	0.86	0.86	0.60	0.93	0.92	0.92	0.93	0.92	0.81	0.92	0.90	0.90	0.82
MME-OL	0.92	0.93	0.92	0.93	0.92	0.59	0.92	0.87	0.88	0.63	0.94	0.93	0.93	0.94	0.93	0.83	0.93	0.91	0.91	0.94
MME-DADNN	0.94	0.95	0.94	0.95	0.94	0.62	0.93	0.89	0.90	0.65	0.95	0.94	0.94	0.95	0.94	0.85	0.94	0.92	0.93	0.96
MME-EDADNN	0.97	0.96	0.96	0.97	0.97	0.75	0.96	0.93	0.94	0.78	0.97	0.96	0.96	0.97	0.96	0.97	0.96	0.97	0.97	0.97
MME-EDADNN-UH	0.98	0.97	0.98	0.98	0.98	0.82	0.98	0.96	0.97	0.88	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

Ban-Banana Gro-Groundnut Wh-Wheat Sug-Sugarcane Mai-Maize

In the above table the value of Banana and Maize crop's precision value is comparatively low than other result.

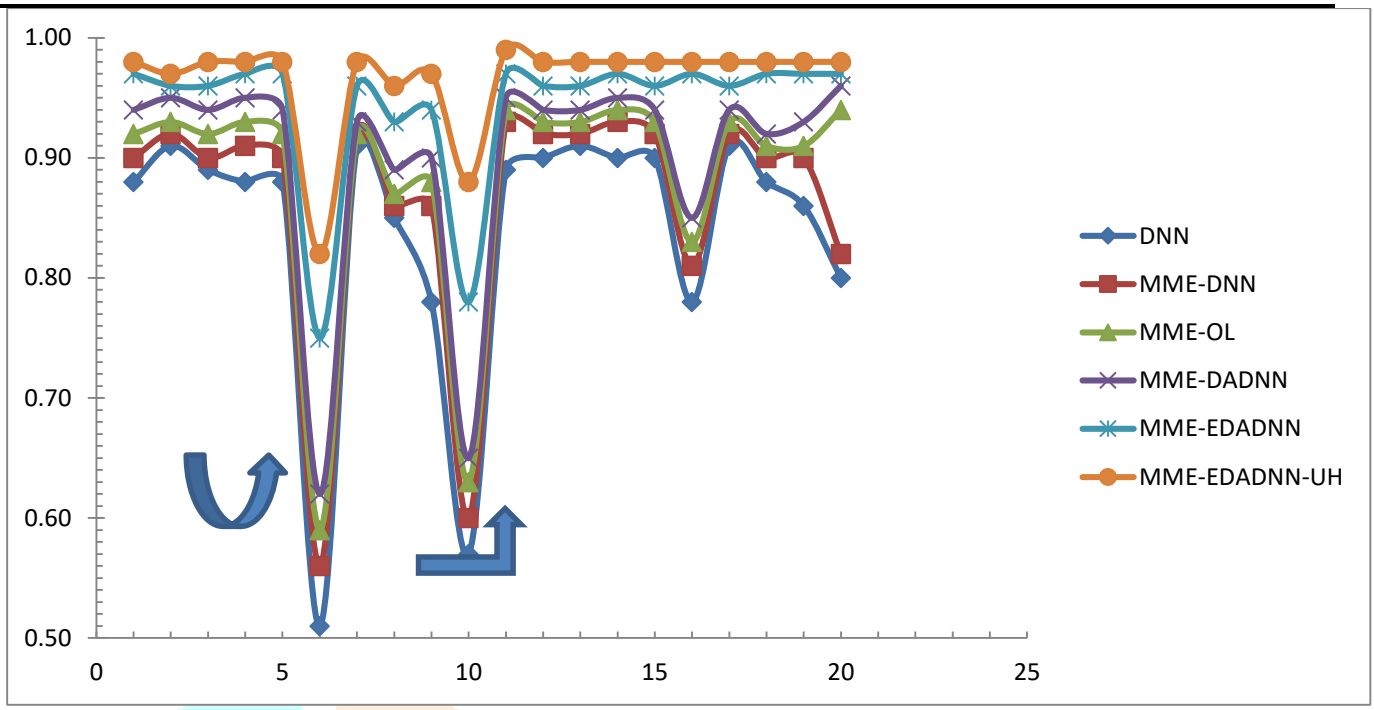


Figure 2. Analysis result of DNN, MME-DNN, MME-OL, MME-DADNN, MME-EDADNN, MME-EDADNN-UH.

In the above figure the pixels of the banana and maize precision value shows lowest rate than other values.

CONCLUSION

This research analysis contributes the crop yield prediction for banana, groundnut, wheat, sugarcane and maize crops with the help of deep neural networks. The MME-DNN applies the statistical model to improve the accuracy. The MME-DADNN uses OGD to set minimum weight of every node. The MME-EDADNN depicts SVR to handle the outliers. The MME-EDADNN-UH handles the uncertainties with the help of MCMC technique. All the research pressed accurate results to crop yield prediction in terms of Accuracy, Precision, Recall and F-Measure. Though those cruises issued smarter than existing, the minimum value of Banana and Maize precision degrades accuracy. This problem can be overcome by selecting the Feature Extraction.

REFERENCES

[1]. Arjun, K. M., "Indian agriculture-status, importance and role in Indian Economy", International Journal of Agriculture and Food Science Technology, 4(4), pp. 343-346,4th November 2013.

[2]. Suryanarayana, T. M. V., & Mistry, P. B., "Principal component regression for crop yield estimation", Springer, Singapore, 2016.

[3]. Jha, P. K., Athanasiadis, P., Gualdi, S., Trabucco, A., Mereu, V., Shelia, V., & Hoogenboom, G., "Using daily data from seasonal forecasts in dynamic crop models for yield prediction: A case study for rice in Nepal's Terai", Agricultural and forest meteorology, 265(2019), pp.349-358, 15th February 2019.

[4]. Koirala, A., Walsh, K. B., Wang, Z., & McCarthy, C., "Deep learning–Method overview and review of use for fruit detection and yield estimation", Computers and Electronics in Agriculture, 162, pp. 219-234, April 2019.

[5]. Manjula, A., & Narsimha, G., "Crop yield prediction with aid of optimal neural network in spatial data mining: new approaches", International Journal of Information & Computation Technology, 6(1), pp. 25-33, 2016.

[6]. Manjula, E., & Djodiltachoumy, S., "A model for prediction of crop yield", International Journal of Computational Intelligence and Informatics, 6(4), pp. 298-305, March 2017.

[7]. Gopal, P. S. M., &Bhargavi, R., "Feature selection for yield prediction using boruta algorithm", International Journal of Pure and Applied Mathematics, 118(22), pp. 139-144, 2018.

[8]. Dahikar, S. S., & Rode, S. V., "Agricultural crop yield prediction using artificial neural network approach", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, 2(1), pp. 683-686, January 2014.

[9]. Rageena, P. M., Abahai, T. A., & Varghese, S. M., "Agriculture crop prediction system based on meteorological information", International Journal of Control Theory and Applications, 9(43), pp.117-130, 2018.

[10]. Khaki, S., & Wang, L., "Crop yield prediction using deep neural networks", Frontiers in plant science, 621(10), pp.1-10, 22nd May 2019.

[11]. Saranya, M., & Sathappan, S., "Multi-model ensemble with deep neural network based crop yield prediction",. International Journal of Advanced Science and Technology, 28(17), 411-419, 2019.

[12]. Saranya, M., & Sathappan, S., "Multi-model ensemble depth adaptive deep neural network for crop yield prediction", International Journal of Recent Technology and Engineering (IJRTE), 8(5), 3088-3093, 2019.

[13]. M.Saranya, Dr.S.Sathappan, "Multi-model Ensemble Enhanced Depth Adaptive Deep Neural Network for Crop Yield Prediction", International Conference on Machine Learning and Data Analytics, Sri Venkateswara University, Tirupathi, 18th and 19th July 2020.

[14]. M.Saranya, Dr.S.Sathappan, "Multi-model Ensemble Enhanced Depth Adaptive Deep Neural Network with Uncertainty Handling for Crop Yield Prediction", Journal of Critical Reviews, 2394-5125, 7(11), pp. 4067-4073, 2020.

[15]. M.Saranya, Dr.S.Sathappan, "Multi-model Ensemble Modified Depth Adaptive Deep Neural Network for Crop Yield Prediction", World Journal of Engineering Research and Technology, 2454-695X, 7(5), pp. 180-192, 2021.