Hybrid algorithm of Neuron Fuzzy Inference System and LDA for Crop Yield Prediction

Rajendra Choudhary and Dr. Aakash Saxena
[1]*M.Tech Student*, [2]*Associate Professor*
Department of Computer Science and Engineering
Compucom Institute of Technology and Management Jaipur

Abstract - Crop yield prediction is important as it can support decision makers in agriculture sector. It also assists in identifying the relevance of attributes which significantly affect the crop yield. Wheat is one of the widely grown crops around the world. Its accurate prediction can solve various problems related to wheat farming. This work analyses how yield of a particular crop is determined by few attributes. In this paper, the models of Fuzzy logic (FL), Adaptive Neuro Fuzzy Inference System (ANFIS) and Multiple Linear Regression (MLR) are used for predicting the yield of wheat by considering biomass, extractable soil water (esw), Radiation and rain as input parameters. The outcome of the prediction models will assist agriculture agencies in providing farmers with valuable information as to which factors contribute to high wheat yield. We compare all these models based on RMSE values. Results show that the ANFIS model performs better than MLR and FL models with a lower RMSE value.

I. INTRODUCTION

Prediction of any natural event requires information regarding its time of occurrence and nature, based on logical analysis. Manual analysis generates inconsistencies due to some factors like fatigue, contradiction of personal perceptions, etc**.** Soft Computing like fuzzy logic, neural computing, etc. can be applied to a wide variety of real world applications as they can handle uncertainties better than traditional methods. It resembles how human reasons which are quite different from how regular methods based on sentential logic, predicate logic operate**.** Predictive models take historic information and are able to predict the future values with less expense and morequickly. They can provide support for human decisions, making them more efficient or in some cases; they can be used to automate entire decision-making processes.

The motivation behind the proposed work is to build and customize such a predictive model which can be used for predicting the crop yields by providing different attributes on which crop yield is dependent.

II. LITERATURE

The previous works for predicting the yields of various crops like rice, wheat using different prediction models are surveyed in this section.

V.R Thakare et.al [2] proposed a fuzzy system that predict maximum yield from crops. This system is able to predict the crop name which can provide maximum yield. It is also able to find the particular soil type and climatic condition which is more suitable to the crop. 15 Soil parameters and 22 crops are considered here.

Rajeshwari G Joshi et.al [3] proposed a Decision Support System (DSS) for predicting crop suitability. They have summarized fuzzy related aspects which can be incorporated in an online farmer assisting system. Various factors for crop selection have been considered by the authors while proposing the DSS. They observe that such a DSS would minimize losses due to fewer yields.

O.K. Chaudhari et.al [4] proposed ANFIS Based Model for maximizing the profit of rice using Multi Objective Linear Programming Problem by optimization method. Labour wages, Machinery Cost, Fertilizer_manure_Cost and Seed_Cost were considered as input variables and the profit through produced yield is the output for maximizing theprofit.

V Mohan Vizhakar et.al [5] proposed a Expert Fuzzy Model which could predict Avalanche. The authors have made an attempt to develop a simpler and better technique for Avalanche prediction using algorithm based on FuzzyLogic.

S.P.Srinivasan et.al [6] proposed a new ANFIS approach which is able to efficiently predict yield of Crop in the supply chain of Jatropa.

Agus Buono et.al [7] implemented a Fuzzy Inference System which was able to increase the resilience of Rice Yield. The authors have considered two data sets: SOI data set from 1877 to 2011 and rainy season dataset from

Indramaya District. They have observed a correlation value of 0.68 between rainy onset and its predicted value.

Jesus Soto et.al [8] proposed how Type 2 and 1 Fuzzy Integrators can be optimized using Genetic Algorithms. Their goal was to develop an ensemble approach for ANFIS models which could make the prediction error as minimal as possible.

III. OUR WORK

After thorough study of the base paper classification error rate is one of the main problems which must be reduced for high performance of the system. These errors are due to high computations or complexity of the system or the processing of the system. As the classification error increases the system accuracy decreases and the accurate prediction of the crops yielding decreases. So we require an efficient approach through which the mean square error rate decreases and classification or prediction recognition increases.

In the base paper, they have used Neuro fuzzy inference system for the prediction of wheat yielding which is rule based system and they have evaluated only one parameter which is Mean square error rate

In our approach we used feature extraction approach using feature extraction algorithm named as Independent Component Analysis in hybridization with neural networks for the prediction and performance is evaluated using mean square error rate and peak signal to noise ratio. We have computed the mean square error rate for the comparison with your base paper to show the optimum performance and also one new parameter which is peak signal to noise ratio

Our MSE is low and Peak signal to noise ratio must be high for high performance of the system

Algorithm:

Step 1: START

Read input samples, $T = \{T1, T2, T3, T4, \dots \dots \dots . . TN\}$

Where T = Training sequence

Step 2:Perform fuzzy c means clustering and generate D = $\{d_1, d_2, d_3, d_4 \dots . d_N\}$ with N=5

Where D is the degree of memberships and N is the number of clusters

Step 3:Generate the cluster centers with membership valuesand update membership values based on cluster assignments

Step 4:Set the training vector based on high degree of membership values. As the membership is high that is more achievable for less error rate probabilities

Step 5:Set the Testing sequences

$$T = \{T_1, T_2, T_3. T_4, \dots \dots \dots \dots T_N\}$$

Where T = Test vectors

Step 6:Predict the Less error rate using multivariate probability distribution and evaluate the less root mean square error rate

Step 7:Repeat Step 2-6 until the completion of number of iterations

Step 8: STOP

IV. EXPERIMENT RESULTS

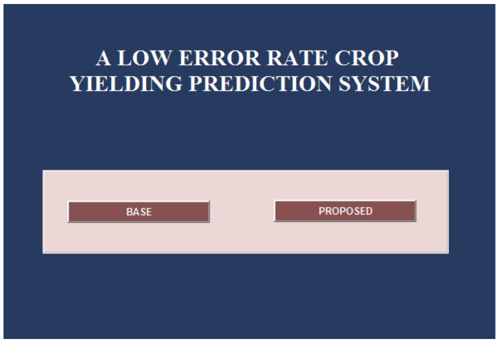

Figure 1: main panel

The figure 1 shows the main panel in which GUI set up tool is used. It consist of user interface controls and using those Ui controls the above mentioned GUI is obtained using pushbuttons and panels.

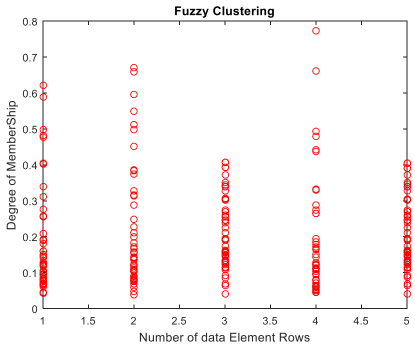

Figure 2: Fuzzy clustering

The figure 2 shows the fuzzy clustering in which degree of membership is evaluated with respect to the data in the dataset for the yielding of wheat. This is an efficient method which allows a piece of data to belong to one or more clusters. The data point that is close to the center will belong to high degree of membership. It is a probability distribution approach which works iteratively to provide each data point a right location

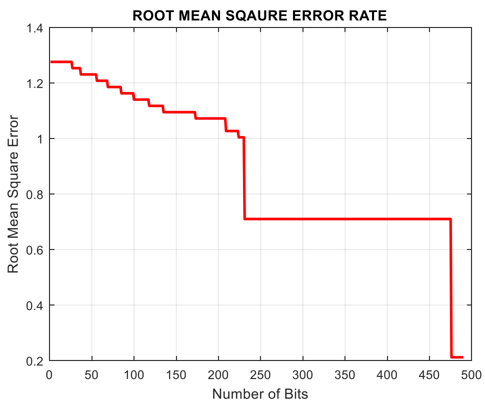

Figure 3: Root mean square error

The above figure shows the learning root mean square error rate in which the yielding of wheat error is evaluated which must be low to have high rate of correctly prediction of yielding. So the system is having less error rates using Adaptive Neuro fuzzy inference system which is our base approach. The ANFIS deals with the training set as the input in terms of degree of memberships. ANFIS builds a fuzzy inference system which works on membership function constraints which are tuned using back propagation procedure to perform less error rates.

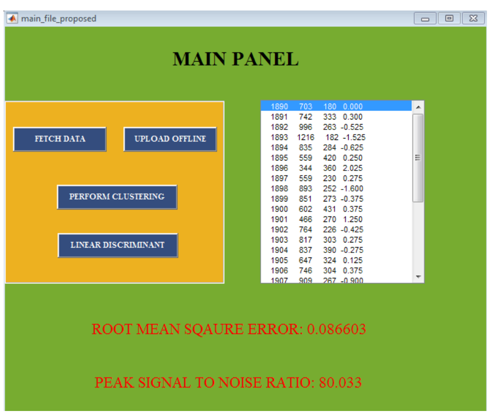

Figure 4: Proposed Panel

The figure 4 shows the above panel which shows the Error rate and Peak signal to noise ratio using linear discriminant analysis.

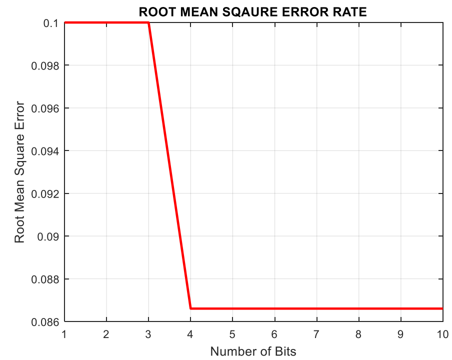

Figure 4: Proposed Root Mean Square Error rate

The above figure is having less error rate prediction using training and testing process which shows that our proposed approach is better than the base approach and shows that the system is more robust in predicting wheat yielding error rates and having high signal to noise ratio. The PSNR must be high for less root mean square error rates.

V. PROPOSED RESULTS

SNo.	Root Mean Square Error	Peak Signal to Noise Ratio
Proposed	0.08	80.32

Comparison Result

Parameter	Base	Proposed
Root Mean Square Error	0.1490	0.08

VI. CONCLUSION

In future we plan to extend this work for different types of crops by considering different parameters. Also, we plan to develop better or improved prediction models for this purpose.

VII. REFERENCES

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