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Rainfall Prediction using Data-Core Based Fuzzy Min-Max Neural Network for Classification

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ABSTRACT
This paper proposes the Rainfall Prediction System by using classification technique. The advanced and modified neural network called Data Core Based Fuzzy Min Max Neural Network (DCFMNN) is used for pattern classification. This classification method is applied to predict Rainfall. The neural network called fuzzy min max neural network (FMNN) that creates hyperboxes for classification and predication, has a problem of overlapping neurons that resoled in DCFMNN to give greater accuracy. This system is composed of forming of hyperboxes, and two kinds of neurons called as Overlapping Neurons and Classifying neurons, and classification used for prediction. For each kind of hyperbox its data core and geometric center of data is calculated. The advantage of this method is it gives high accuracy and strong robustness. According to evaluation results we can say that this system gives better prediction of rainfall and classification tool in real environment.

Keywords **–** Classifying and overlapping neuron, Data core based fuzzy min max neural network, geometric center, rainfall prediction and classification.

I. INTRODUCTION

The rainfall prediction is very much important in various fields like agriculture, construction etc. here we have implemented a system for predicting rainfall using classification method that is Data core based fuzzy min max neural network (DCFMMNN) [1].

Previous research has been done using Artificial Neural Network (ANN). ARIMA (1, 1, 1) model and Artificial Neural Network (ANN) models like Multi-Layer Perceptron (MLP), Functional-link Artificial Neural Network (FLANN) and Legendre Polynomial Equation (LPE) were used to predict the time series data. The accurate results were given by MLP, FLANN and LPE for complex time series model. Results of all Artificial Neural Network model matched closely with the ARIMA (1, 1, 1) model with minimum Absolute Average Percentage Error (AAPE). Comparing the different ANN models for time series analysis, it was found that prediction results of FLANN is better than compared to ARIMA model with less Absolute Average Percentage Error (AAPE) for the measured rainfall data.

Here we are using DCFMMNN [1] classification technique for prediction. The set of data is used for training with its class value, then new data is entered to check the prediction. This time we are not giving class value as an input. The system will train with training data as well as it will gain knowledge from testing data. It will again train itself will this data.

1.1 basic concepts

Basic concept of data core based fuzzy min max neural network (DCFMMNN) [1].

1.1.1 Hyperbox

A fuzzy set hyperbox is an N-dimensional box defined by its minimum and maximum values. Each hyperbox has membership function to find out membership of the pattern.

1.1.2 Data core

Data core is the mean value of all data points in the same hyperbox. When patterns fall into any hyperbox the data core will be calculated as follows:

$$D = (X_1+X_2+X_3+X_4) / 2 \quad (1)$$

Where X_1 to X_4 are data points.

1.1.3 Geometric center

Geometric center is the center of the hyperbox. It is calculated as follows:

$$G = (X_1 + X_4) / 2 \quad (2)$$

1.1.4 Overlapping Neurons

When two hyperboxes of two different classes overlapped on each other there will be overlapping section will appear, if any pattern falls inside in this section will be considered as overlapping neurons.

1.1.5 Classifying neurons

Patterns belong to any hyperboxes without overlapping is called as classifying neurons.

1.2 Fuzzy Min-Max Neural Network (FMMNN)

The FMMNN [2] is formed using hyperbox fuzzy sets. The FMMNN defines an n-dimensional region which has patterns inside it with full class membership. Each hyperbox has minimum and maximum value with its membership function. It has 3 main steps: expansion, overlap test and contraction. The learning process start with finding hyperbox with existing class, if found then it will go for expansion, if it is necessary. If expansion is not possible then it will form a new hyperbox. After expansion it will go for overlapping test, if there is no overlap with different classes then hyperboxes are isolated and there is no need of contraction. If such a region exist then it will apply contraction and eliminate this area to achieve great accuracy. The representation of the hyperbox is shown in following figure.

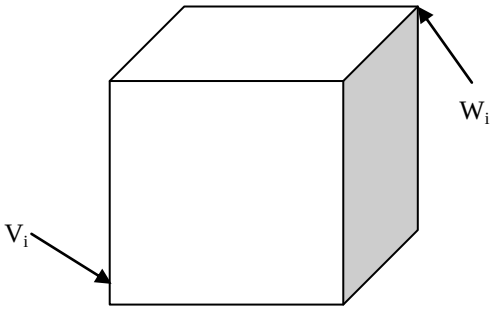

Fig1. Hyperbox with min max values

Each hyperbox is defined as

$$Bj = \{X, Vj, Wj, bj (X, Vj, Wj)\} \quad (3)$$

Where X is a set of input patterns and V_j and W_j are minimum and maximum values of hyperbox respectively. j is number of hyperbox. b_j (x, v_j, w_j) is the membership function.

$$bj(X_h) = \frac{1}{2n}\sum_{i-1}^{n} [\max(0,1-\max(0,\gamma\min(1, x_{h,i}-w_{j,i}))) + \max(0,1-\max(0,\gamma\min(1,v_{j,i}-x_{h,i})))] \quad (4)$$

Where X_h belongs to set of input patterns.

II. RELATED WORK

The lot of research carried out on rainfall prediction Indrabayu designed a system which is based on data series he proposed a new approach for rainfall prediction method, which is the combination of Support Vector Machine (SVM) and Fuzzy Logic methods. He obtained data of 10 years (2001-2010) that is climatological data from PT LAPAN Bandung and Meteorology, Climatology and Geophysics Region IV Makassar, Indonesia. Another researcher have done research on predicting the rainfall by using series data, Santosh Nanda and his mates have used artificial neural network (ANN) and ARIMA model for rainfall prediction. Where ARIMA means autoregressive integrated moving average (ARIMA) models.

III. METHODOLOGY

In proposed system we are using DCFMMNN technique to make prediction. The DCFMMNN has advantage over traditional FMMNN, it gives more accuracy for classification. The rate of misclassification of DCFMMNN is much less from other traditional FMMNN. It has more powerful membership functions to calculate membership degree; it also deals with overlapping area of two different classes.

3.1 . Learning algorithm

The system includes three main steps: expansion of hyperboxes, overlapping test and adding overlapping neuron (OLN), if needed. Here we are providing a set for training which consists of input patterns with its class values. First of all we are using these ordered pair to form classifying neuron (CN). If there is overlap area between hyperboxes belongs to two different classes, a new OLN is added. The following is the flowchart of learning algorithm.

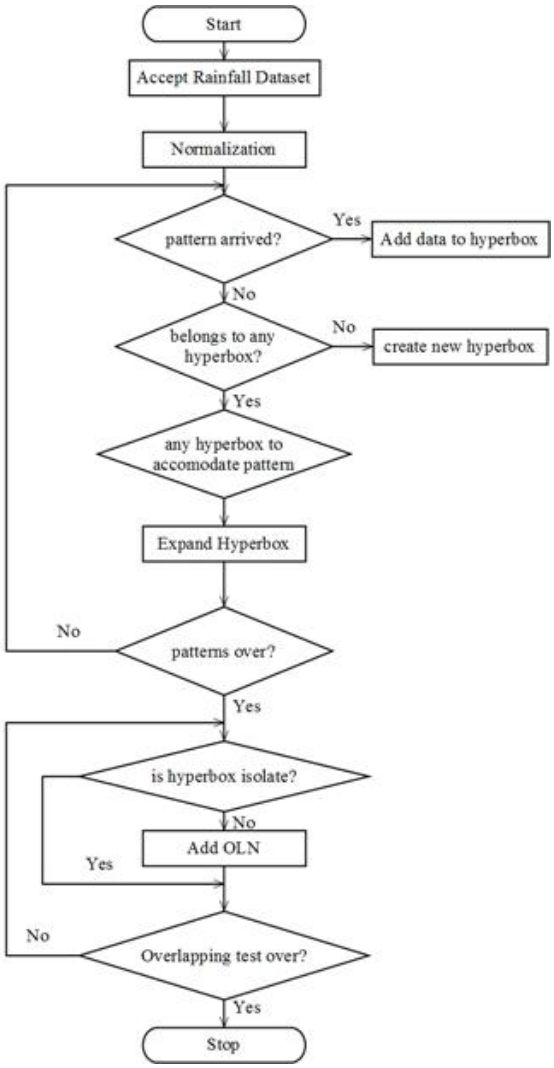

Fig2. Learning Algorithm of system

We get to know whether overlap has occurred or not by subtracting old value from new value, if answer is greater than 0 then it shows an overlap.

Following are the test cases that we have used to check overlap of hyperboxes:

Case 1: $V_{j,i} < V_{k,i} < W_{j,i} < W_{k,i}$

$V'_{m+oi} = V_{k\,I}$, $W_{m+oi} = W_{j,i.}$

Case 2: $V_{k,i} < V_{j,i} < W_{k,i} < W_{j,i}$

$V'_{m+oi} = V_{j\,i}$, $W_{m+oi} = W_{k,\,i.}$

Case 3: $V_{j,\,i} < V_{k,i} < W_{k,i} < W_{j,i}$

$V'_{m+oi} = V_{k\,i}$, $W_{m+oi} = W_{k,\,i.}$

Case 4: $V_{k,\,i} < V_{j,\,i} < W_{j,\,i} < W_{k,i}$

$V'_{m+oi} = V_{j\,i}$, $W_{m+oi} = W_{j,\,i.}$

Where V and W are min and max points of the hyperbox respectively.

3.2 Classifying algorithm

If the value of OLN membership function is zero then we can say that there is no overlap. If the membership function gives non-zero value then it is state that, there is a pattern which falls into an overlapped area belongs to different classes. The flowchart for classifying algorithm is shown below:

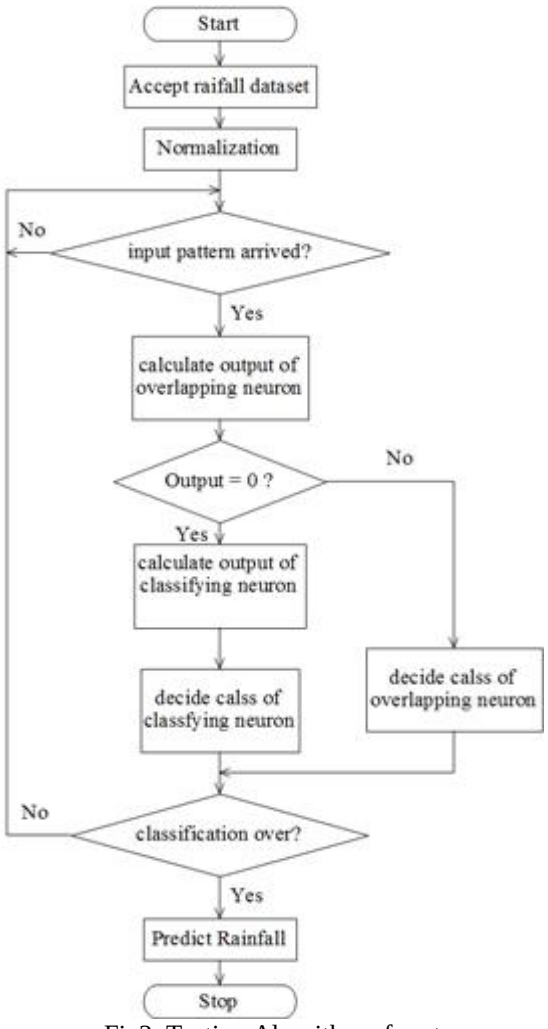

Fig2. Testing Algorithm of system

IV. Experimental Results

We have used rainfall prediction dataset to train our system 50% data we have used for training and remaining to check the output. The hyperboxes are created using training dataset. We have used to classes.

Number of records	Overlapping neurons	Classifying neuron
22	2	20

Table1: number of neurons with classification.

The result set of predicted rainfall is as follows:

Temperature	Humidity	Wind speed	Pressure	Rainfall prediction
26	33	8	31	YES
27	30	9	33	YES
30	36	11	33	NO
25	30	15	26	NO
25	34	14	30	YES
41	35	10	33	NO
25	35	10	32	YES

Table 2: prediction results

Here Rainfall prediction column shows whether rainfall will occur or not. When we compared this data with already available data its accuracy was 100%. As we know there are so many parameters we can add to predict the rainfall; we used these parameters for our work. According to this data accuracy of result was great.

V. Conclusion

This Paper proposes an innovative system for rainfall prediction using DCFMMNN. We used the dataset for training, which forms hyperboxes and deals with the overlapping area, so there will not be any misclassifications. The remaining data was used for testing the system. It gives result as where rainfall will occur or not. The results we got from this system shows that it can be useful for rainfall prediction with higher accuracy.

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References

[1] Hauguang Zhang, Jinhai Liu, Dazhong Ma, Zhanshan Wang, *Data-Core-Based Fuzzy Min-Max Neural Network for Pattern Classification*, IEEE transactions on Neural Network, Vol-22, No 12, 2011.

[2] Patrick K. Simpson, *fuzzy min max neural network part -1. Classification*, IEEE transactions on Neural Network 3,(1992) 776-786.

[3] Patrick K. Simpson, *fuzzy min max neural network part -II. Clustering*, IEEE transactions, fuzzy system, Vol. 1, no. 1, pp 32-45 Feb 1993.

[4] L. A. Zadeh, "*Fuzzy sets*," Inf. Control, vol. 8, no. 3, pp. 338–353, 1965.

[5] A. V. Nandedkar and P. K. Biswas, "*A fuzzy min-max neural network classifier with compensatory neuron architecture,"* IEEE Trans. Neural Netw., vol. 18, no. 1, pp. 42–54, Jan. 2007.

[6] A. Quteishat, C. P. Lim, and K. S. Tan, *"A modified fuzzy min-max neural network with a genetic-algorithm-based rule extractor pattern classification,"* IEEE Trans. Syst., Man, Cybern. Part A: Syst. Humans, vol. 40, no. 3, pp. 641–650, May 2010.

[7] N. P. Archer and S. Wang, *"Fuzzy set representation of neural network classification boundaries,"* IEEE Trans. Syst., Man Cybern., vol. 21, no. 4, pp. 735–742, Jul. 1991.