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Atmospheric Condition based Clustering using ART Neural

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ABSTRACT

Ambient air temperatures prediction is of a concern in environment, industry and agriculture. The increase of average temperature results in global warming. The aim of this research is to develop artificial neural network based clustering method for ambient atmospheric condition prediction in Indian city. In this paper, we presented a clustering method that classifies cities based on atmospheric conditions like Temperature, Pressure and Humidity. Data representing Month-wise atmospheric conditions are presented to ART Neural Network to form clusters which represents association in between two or more cities. Such associations predict atmospheric conditions of one city on the bases of another. ART based clustering method shows that the months of two cities which fall in the same cluster, represent similar atmospheric conditions in them.

Keywords: *Atmospheric Conditions, ART, Clusters, Temperature, Pressure, Humidity*

I. INTRODUCTION

The current state of the atmosphere is the result of a multitude of facts. The energy from the sun produces the movements or currents in the atmosphere. This energy, the Earth's movement relative to the sun and the components of the atmosphere and of the Earth's surface maintains the long-term climate, the short-term weather, and the temperature conditions. These provide conditions fit for the forms of life found on Earth. The condition of the physical world affects and is affected by the life present. The entire system is therefore called the biogeochemical system. In the last century especially, this system which evolved over billions of years has been subject to rapid changes due to industrial activities increasing at unprecedented rates. Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location. Human beings have attempted to predict the weather informally for millennia, and formally since the nineteenth century. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere and using scientific understanding of atmospheric processes to project how the atmosphere will evolve.

We applied ART1 Artificial Neural Network (ANN) and statistical models [1, 3, 4]. The studies demonstrated that the neural network models outperform multiple linear regression models through handling non-linear associations between variables. ANN has been extensively used for prediction in different applications [9, 10, 11, 12].It has been found that extreme cold and heat can affect on crops and live stock. The results showed that ANN is able to forecast air temperature throughout the year with minimum mean absolute error (MAE) and the inclusion of rainfall as input to the model, improves prediction accuracy. Temperature, Air Pressure and Humidity data of ten different cities of India are collected for twelve months. It has been arranged month wise and then ART1 clustering algorithm is applied on this data to form clusters to show correlation in between the months of one city to another [5, 6]. The experimental results show that the atmospherics conditions of particular months of a city is correlated with particular months of another city. This correlation helps to predict atmospheric conditions of one city with the help of other cities' atmospheric conditions of other cities in the same cluster.

II. CLUSTERING OF CITIES USING ADAPTIVE RESONANCE THEORY

For clustering atmospheric condition of any city month wise data has been collected, ART1 algorithm [5, 6] has been applied. F1 and F2 layers of ART1 are fully connected with top-down weights and bottom-up weights. The Orientation subsystem consists of the vigilance parameter ρ. The input pattern vectors PH=0 to 3 are presented at the F1 layer. Each input pattern presented at the F1 layer activates a node (winner) in the F2 layer. The F2 layer reads out the top-down expectation to F1, where the winner is compared with the input vector. The vigilance parameter determines the mismatch that is to be tolerated. If the match between the winner and the input vector is within the tolerance, the top-down weights corresponding to the winner are modified. Our architecture of ART1 based network [9] for clustering cities consists of 12 nodes in the F1 layer, with each node presented with the binary value 0 or 1. The pattern vector PH, which represents the Temperature, Air Pressure and Humidity data, presented at the F1 layer. The F2 layer consists of a variable number of nodes corresponding to the number of clusters [8]. Most of the techniques for classification [7, 2] divide number of patterns into predefined number of classes. We used ART1 neural network based clustering technique to remove this drawback.

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III. PROPOSED METHODOLOGY

The pattern vector PH, which represents the Temperature, Air Pressure and Humidity data, presented at the F1 layer. It is a 12 bit binary pattern.

A. Collection of Data

Data has been collected is converted into binary bit stream.

B. Clustering of Date

Binary bit stream has been passed to ART1 for clustering.

C. Cluster Identification

Cluster formed is being identified on city-wise data.

D. Prediction of Atmospheric Conditions

On the bases of the co-relation in between two or more cities atmospheric condition is being predicted for a particular city.

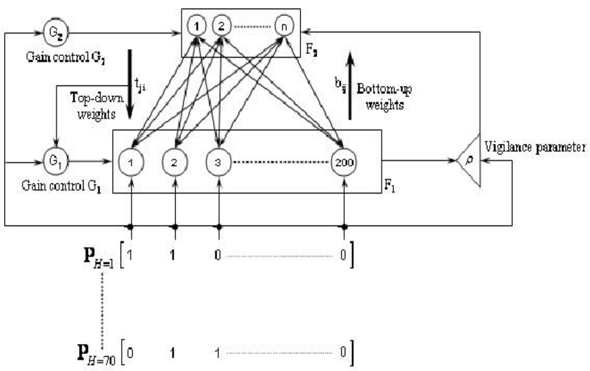

Figure.1 Architecture of ART1 Neural Network

3.1 ART1 Algorithm

Input:

i. Feature vectors PH=1 to m, each representing the feature points of a fingerprint.
ii. The vigilance parameter value (ρ). We tested the ART1_Clustering algorithm by varying the ρ between the values 0.7 and 0.98.

Output: Clusters of hosts grouped according to the similarity determined by ρ.

Step 1: Initialization step
i. Set nodes in F1 layer and F2 layer to zero
ii. Initialize top-down (t_{ji}) and bottom-up (b_{ji}) weights $t_{ji} = 1$ and $b_{ji} = 1/(n+1)$, where n is the size of the input vector; (n=200)
iii. Initialize the vigilance parameter(ρ), $.03 \leq \rho \leq .05$

Step 2: Repeat steps 3-10 until all input vectors PH are presented to the F1 layer.
Step 3: Present input vector P_H at F1.
Step 4: Compute input ‘yj’ for each node in F2 layer using:

$$y_j = \sum_{i=1}^{200} P_i \times b_{ij}$$

Step 5: Determine k, the node in F2 that has the largest yk

$$y_k = \sum_{j=1}^{\text{number of nodes in } F_2} \max(y_j)$$

Step 6: Compute activation X_k for the node k in F1

$$X_i^* = t_{ki} \times P_i \quad where\ i = 1 \ldots 200$$

Step 7: Calculate the similarity between X_k and input P_H using:

$$\frac{\|X_k^*\|}{\|P_H\|} = \frac{\sum_{i=1}^{200} X_i^*}{\sum_{i=1}^{200} P_i}$$

Step 8: Compare the similarity calculated in Step 7 with the vigilance parameter:

$$if \left(\frac{\|X_k^*\|}{\|P_H\|} > \rho \right)$$

begin

Associate input PH with node k Temporarily disable node k by setting its activation to 0

ii. Update top-down weights of node k

$$t_{ki}(new) = t_{ki} \times P_i \quad where\ i = 1 \ldots 200$$

end

else

Step 9: Create a new node in F2 layer
begin
i. Create a new node l
ii. Initialize the top-down weights ‘tli’ to the current input pattern
ii.Initialize bottom-up weights for the new node l

$$b_{il}(new) = \frac{X_i^*}{0.5 + \sum_{i=1}^{200} X_i^*} \quad where\ i = 1 \ldots 200$$

end

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Step 10: Goto Step 2.
Step 11: End

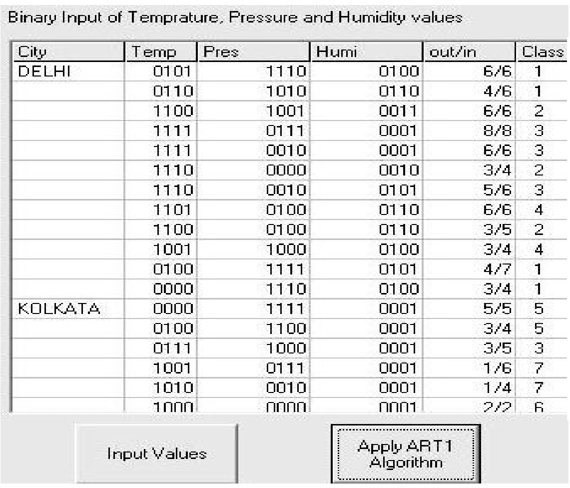
Most of the techniques for classification [7] divide number of patterns into predefined number of classes. We use our ART1 neural network based clustering technique to remove this drawback.

4. EXPERIMENTAL RESULT

Data represents the Temperature, Air Pressure and Humidity is collected for ten different cities of India, namely – Delhi, Kolcata, Bhopal, Mumbai, Jaiput, Amritsar, Cochin, Lacknow, Bhubneshwar, Guwahati, which are geographically well separated from each other.

	NEW DELHI		
	TEMP	PRESSURE	HUMIDITY
JAN	25	1014	67
FEB	26	1010	96
MARCH	32	1009	48
APRIL	35	1007	15
MAY	35	1002	17
JUNE	34	1000	34
JULY	34	1002	71
AUG	33	1004	86
SEPT	32	1004	87
OCT	29	1008	61
NOV	24	1015	71
DEC	20	1014	64

Figure 2. Data collected for city Delhi – Temperature, Pressure, Humidity


Binary Input of Temprature, Pressure and Humidity values

City	Temp	Pres	Humi	out/in	Class
DELHI	0101	1110	0100	6/6	1
	0110	1010	0110	4/6	1
	1100	1001	0011	6/6	2
	1111	0111	0001	8/8	3
	1111	0010	0001	6/6	3
	1110	0000	0010	3/4	2
	1110	0010	0101	5/6	3
	1101	0100	0110	6/6	4
	1100	0100	0110	3/5	2
	1001	1000	0100	3/4	4
	0100	1111	0101	4/7	1
	0000	1110	0100	3/4	1
KOLKATA	0000	1111	0001	5/5	5
	0100	1100	0001	3/4	5
	0111	1000	0001	3/5	3
	1001	0111	0001	1/6	7
	1010	0010	0001	1/4	7
	1000	0000	0001	2/2	6

Figure 3. Application of ART1 algorithm on binary form of Temperature, Pressure, Humidity data to generate class code.

ART1 algorithm has been applied on the collected data of three important atmospheric conditions that is temperature, pressure, humidity.

	Delhi	Kolcata	Bhopal	Mumbai	Jaipur	Amritsar	Cochin	Lacknow	Bhubneshwa	Guwahati
JAN	1	5	7	5	7	1	7	7	7	7
FAB	1	5	7	7	1	7	3	7	7	7
MAR	2	3	2	7	7	7	7	7	6	7
APR	3	7	7	7	7	7	7	7	7	7
MAY	3	7	7	7	3	7	3	7	6	6
JUN	2	6	2	7	7	7	5	7	3	4
JUL	3	3	7	7	4	3	7	7	3	6
AUG	4	3	7	7	7	7	7	7	7	6
SEP	2	3	7	7	7	7	7	7	3	7
OCT	4	3	7	7	7	7	5	4	7	7
NOV	1	5	7	7	7	7	7	7	7	7
DEC	1	5	7	7	7	7	7	1	7	1

Figure 4: Clustering of twelve months of ten different cities

As a final result the two major clusters coming out are represented by cross and check in the figure 4. These clusters show that there is a close association in between atmospheric conditions of the cities. It also shows that the months of any particular cities which in the same category are either having same atmospheric conditions or the conditions are going to become similar. Such associations are meaningful in prediction of atmospheric conditions which are helpful in protection of loss of human, cattle life and crops.

5. CONCLUSION

Ambient atmospheric condition prediction is of a great concern in environment, industry and agriculture. ART1 based clustering system based on atmospheric conditions like temperature, pressure and humidity. The proposed ART1 based clustering method is shown very efficient in correlating the atmospheric conditions in between two or more cities and hence helps in prediction of atmospheric conditions in one particular city based on atmospheric conditions of another city of the same cluster.

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