Feedback Digital Learning Network using the Frequency of Occurrence

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Abstract

A pattern recognition system based on the n-tuple technique is developed and evaluated for use in classifying non-deterministic data with particular reference to non-restrained hand-written India numerals.

The system presented in this research fulfills the requirements of simplicity and efficiency making it attractive to practical use in present day industrial environments. This simplicity of operation is afforded by the self evolving nature of the classifier, since it is based on a training phase where the recognition logic is developed.

The obtained results showed that a very high performance can be achieved, providing evidence of the validity of the proposed techniques.

التغذية الرجعية في شبكة تعلم الرقمية باستخدام تكرارية الحدوث

المستخلص :

يعالج البحث مسألة بناء وتطوير منظومة تميز الأنماط غير المحددة خاصة بالأرقام الهندية اليدوية المستخدمة من قبل العرب.

في هذه البحث تؤمن المنظومة المقترحة الاحتياجات المطلوبة من حيث البساطة والكفاءة لتجعلها ملائمة تماماً للتطبيقات العملية في البيئة الحالية. وتأتي البساطة في العمل من قابلية المنظومة على الاستنباط الذاتي بالاعتماد على طور التدريب أولا لإنشاء مبدأ التميز ونرى أن أداة التميز للمنظومة بعد إضافة الطرق الجديدة كانت جيدة وتدل على أهمية ونجاح التقنيات المضافة.

1. Introduction

In this search explain improved techniques for improving the performance of digital learning networks which implements the n-tuple method using feedback of pattern recognition. Here we presents new techniques whereby the performance and the confidence of classification by learning network can be increased through the treatment of the features as a group of application of feedback [1,2].

All the experiments performed in this research deal with hand-written numerals 0 to 9. The choice of hand-written numerals is made due to the fundamental consideration that if highly accurate recognition of hand-written numerals Arabic was achieved this would obviously prove to be a most effective and immediately usable tool in man / machine communication[3,4]. Also, the techniques would offer scope for application to other pattern recognition tasks, in addition the efficiency and optimality of performance can readily be assessed due to the fact that the data to be recognized. All the computer programs work was done by using visual basic language (version 6). The programs are implemented and executed for testing purposes using IBM personal computer, with processor Pentium IV (1700 GHz).

2. The Pattern Classes Used

All experiment used the same pattern database which consisted of 1000 patterns of the 10 numerals. They were taken from 100 different subjects, Handwritten by different subjects. These were input to the computer via a scanner interface. The computer samples a binary image of 16* 16 pixels, which contains a group of these handwritten characters.

This patterns will used later for training and testing. The mapping used for the construction of the n –tuple is a random mapping

(i.e. the n-tuple elements are chosen randomly from the input pattern pixel matrix) and no attempt is made here for its optimization. It is chosen to be random, rather than ordered, since it is well known that random mapping in general gives better performance. The n-tuple size determines the size of RAM used in each discriminator and a size 3 for the n-tuples give adequate performance for the used pattern classes. In fact, this was shown to be a good compromise between the performance and the amount of RAM required for the implementation of the recognizer, which increases rapidly when the n-tuple size increases[5]. This shall also be used here.

3. (FDLNs) Using the Frequency of Occurrence

A new method for enhancing the performance of the feedback digital learning network, a technique which is an embodiment of the n-tuple method of pattern recognition is presented. It uses the n-tuple states (defined as the particular combinations of 0' s and 1's for the n-tuple) which occur frequently in the input pattern for performance enhancement. The structure of the feedback digital learning network is modified in order to detect these states and use them to adjust the output responses of the discriminators according to the number of such states occurring in the input pattern. It was found that when these states are grouped into small groups, (The performance is enhanced further. many arrangements for such groups and their weightings were tried.)The resulting structure was applied to the recognition of handwritten numerals. The hardware implementation for such a recognizer is also presented.

As mentioned earlier, the undesirable phenomenon of overgeneralization of a particular discriminator being increased to the extent that not only are unseen patterns of its class recognized but also many patterns of other classes.

Overgeneralization occurs, for example, with increasing training set size due to the 'saturation' of the memory with 1's by the increasingly likely occurrence of ' rogue ' states of n-tuples which occur only infrequently. This underlines the weakness of the simple (one bit per state) n-tuple method for feature extraction since no differentiation is made between commonly occurring states and rare ones. When a training pattern is presented to the system, the state of each n-tuple is looked-up in the appropriate discriminator. If a particular state has not been encountered before in a pattern of that class, the corresponding location is set. If it has been seen before, no further action is taken. A rogue pattern for a particular class has rogue states of n-tuples which occur very infrequently for the class.

The digital learning network which have been trained on the rogue sets of inputs are more likely to cause classification error. This drawback becomes evident especially in problems that deal with unconstrained hand writing characters. The recognizer is likely to be trained on n-tuple states which occur very infrequently since the data possesses a large degree of variations within classes.

This technique is shown through the Flowchart in figure (1).

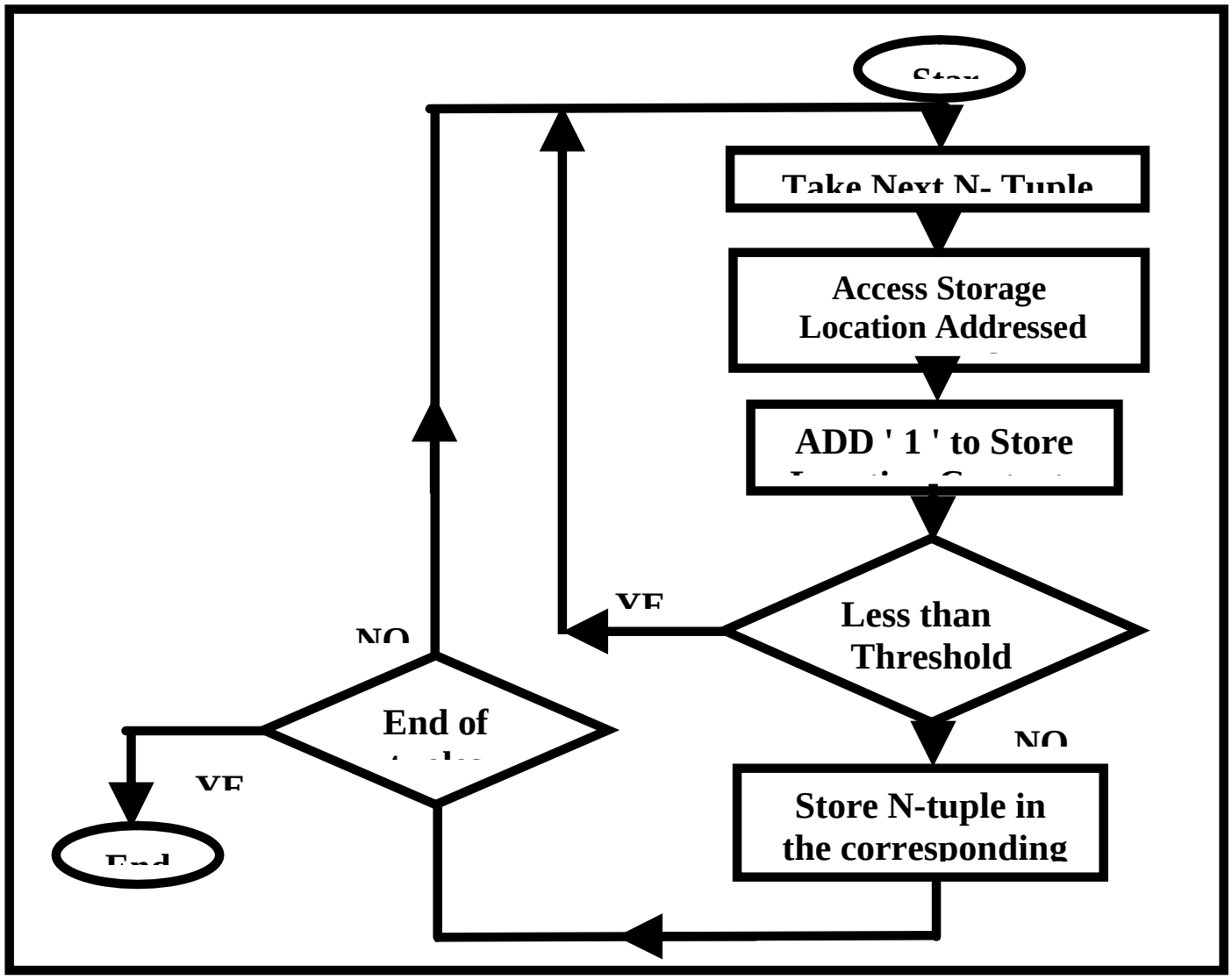


Figure (1) Flowchart of the process of Frequency of

The employment in this technique requires that a count be kept of the number of times each n-tuple state occurs. In software, a memory array of words was assigned to keep a record of the number of times all the possible n-tuple states had occurred during the training of a single discriminator. As each n- tuple is sampled, its corresponding array register is first incremented value is equal to the memory element threshold value.

If it is, a 1 is stored in the appropriate memory element location and the next sample is taken; if not the next n-tuple is sampled straight away. When a discriminator has been trained, the array is cleared for use in training the next. This investigation started

from the fact that there is usually a number of states that occur more often than others in any one n-tuple. Such states represent important common features between the patterns of that class. It thus seems reasonable to deduce that when the unknown input pattern contains more of the frequently occurring states in one class, it is more probable to belong to that class.

A series of experiments were carried out in which a range of memory element threshold values T were used in order to ' prune ' the n-tuple states which occur infrequently. The probability distribution of states for each individual n-tuple in the input pattern for different classes was therefore investigated. For this, ten classes were considered ; the handwritten numerals India 0 to 9 the patterns are the same but there they were used for a different purpose; namely, and the implementation of more than one discriminator per class for performance enhancement.

4. The Frequency of Occurrence Experiments

A series of experiments were carried out in which a range of RAM threshold value T were used in order to ' prune ' the n-tuple states which occur infrequently. The probability distribution of states for each n-tuple in the input pattern for different classes was therefore investigated. For this, ten classes were considered ; the handwritten India numerals 0 to 9 the patterns are the same but there they were used

for a different purpose and the implementation of more than one discriminator per class for performance enhancement.

The results are shown in table (1) for each, together with the average result for all patterns tested. The results indicate that a considerable improvement in the performance of the system takes place by increasing the value of threshold T up to an optimum performance

occurred at T equals to 10, The best performance occurs at n-tuple size of 4 and it is random mapping. The percentage of correctly classified test patterns rise to 80 %. We could decrease the rejection level of the network to 20 % mainly because it is large emphasizing on the nature of the features and providing high confidence to the responses that achieved from the network.

Class set size =120, Disc. no.=10				
Feedback Digital Learning Networks using the Frequency of Occurrence	***n-tuple***	***3***	***4***	***8***
	correct	**78.33%**	**80%**	**75%**
	reject	**21.67%**	**20%**	**25%**
	error	**0%**	**0%**	**0%**

Table 1 : Results of FDLNs using the Frequency of Occurrence

-/ Our interest is in the states with high frequency of occurrence. These are taken to be those that occur with a frequency equal and above 80% of the maximum frequency of occurrence in that 4-tuple.

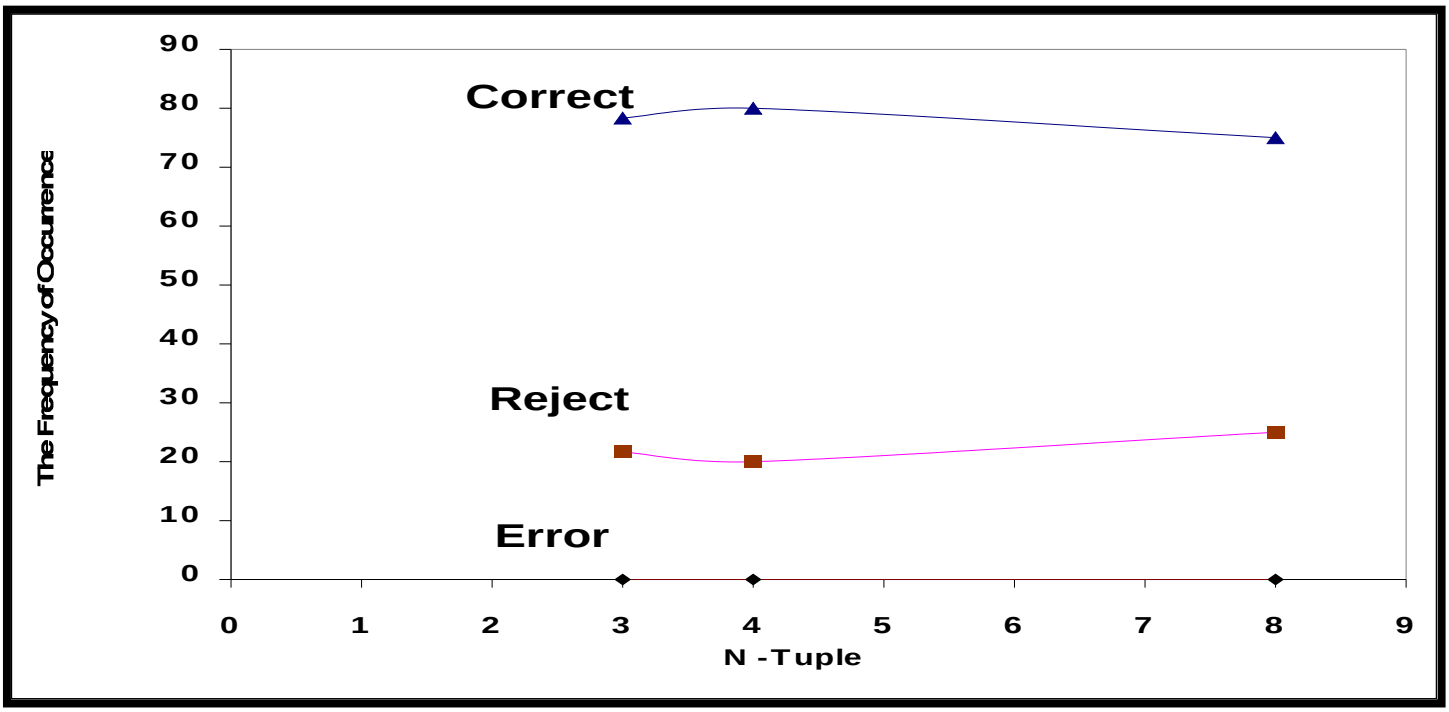
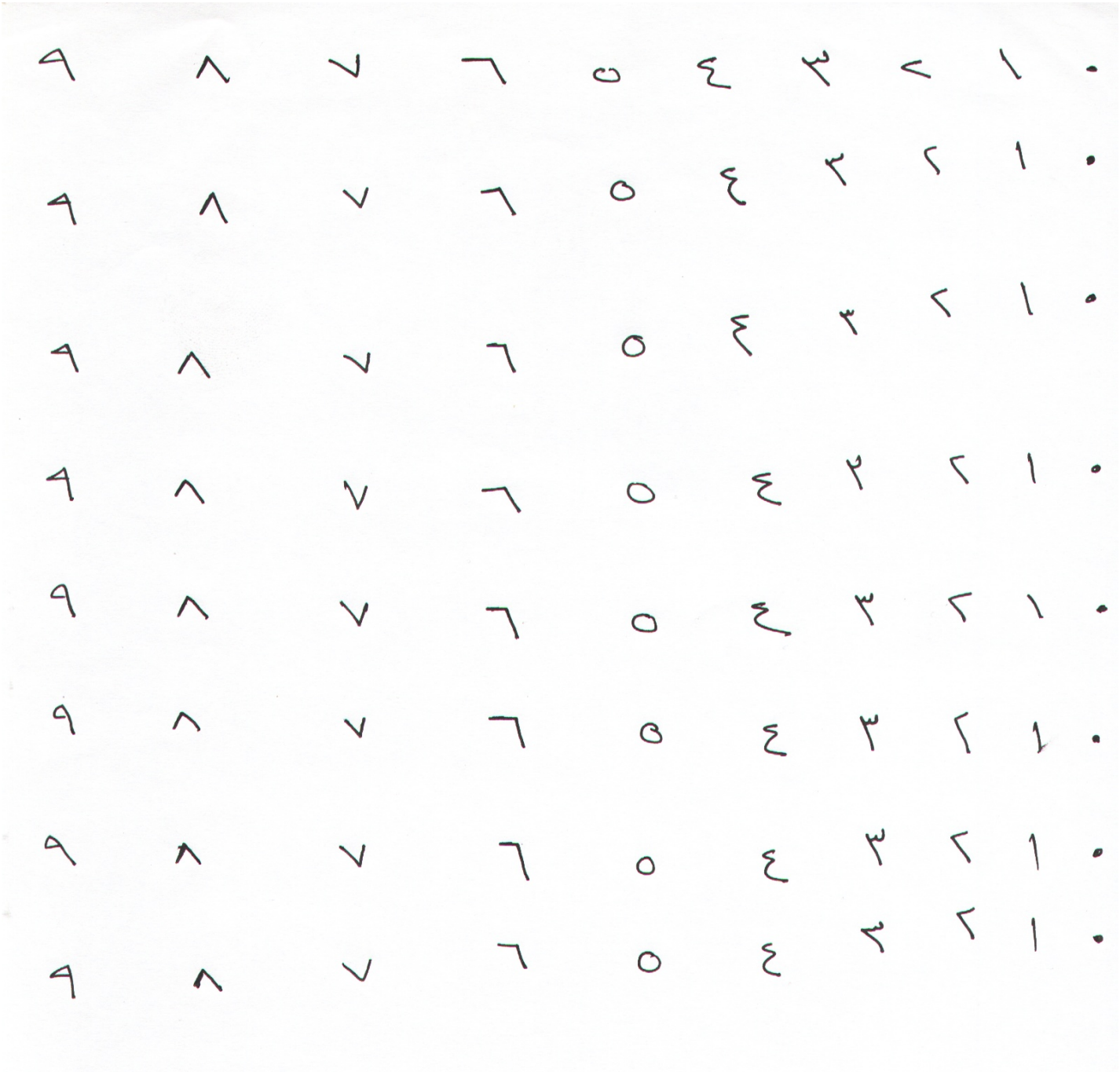


Figure (2) Classification of the frequency of

Some Examples of Patterns That Used in This Work



5. Conclusions

The primary objective of the work reported in this search was to investigate various techniques so as to improve the recognition performance of non-deterministic data using digital learning networks which implement n-tuple method of pattern recognition. In this class of data, unconstrained hand-writing characters were chosen to optimize the techniques which can be applied to other forms of data. The Frequency of Occurrence strategy proved to be a useful approach to deal with the gray scale images faced with digital learning networks. This approach had fast training and simple hardware design facilities. Using this strategy the performance of the recognizer was increased to 80 % correct and the reject was decreased to 20 %.

References

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