Feedback Digital Learning Network with Advanced RAM

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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.

1. Introduction :

In this paper , the performance of digital learning networks has been improved by using the n-tuple method with feedback of pattern recognition . Here we have presented a new technique 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 Arabic numerals was achieved , this would obviously prove to be the 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

2. The Pattern Classes Used :

All experiments have used the same pattern database which consisted of 1000 patterns of the 10 numerals. They were taken from 100 different Handwritten subjects. These patterns were entered 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.

These patterns will be 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 an adequate performance for the used pattern classes. In fact, this was shown to be a good compromise between the performance and the size of RAM required for the implementation of the recognizer, which increases rapidly when the n-tuple size increases[5]. This will also be used later in this paper.

3. Feedback Digital Learning Network(FDLN) with Advanced RAM :

At present there is a large development of the pattern recognition systems. One of the possibilities is the utilization of neural nets. This cooperation has been mainly focused on the neural nets with n-tuple method and advanced RAM . The network of advanced RAM could respond directly to multi-level values and so it could provide a powerful pattern recognition properties. The natural progression of this technique was to consider the recognition of gray scale images.

The advanced RAM technique may be considered similar to template matching, which measures the nearest distance of the test pattern to the stored reference patterns. However, unlike template matching, for advanced RAM, no distance measure calculations are required as each advanced RAM operates as a simple ‘look-up-table’ and thereby enables fast operational speeds. Also, several training images can be stored within each net and thereby provide several patterns per class.

The digital learning networks are composed of high amount of executive units – neurons. In this case the executive unit is the advanced RAM as illustrated in figure (1).

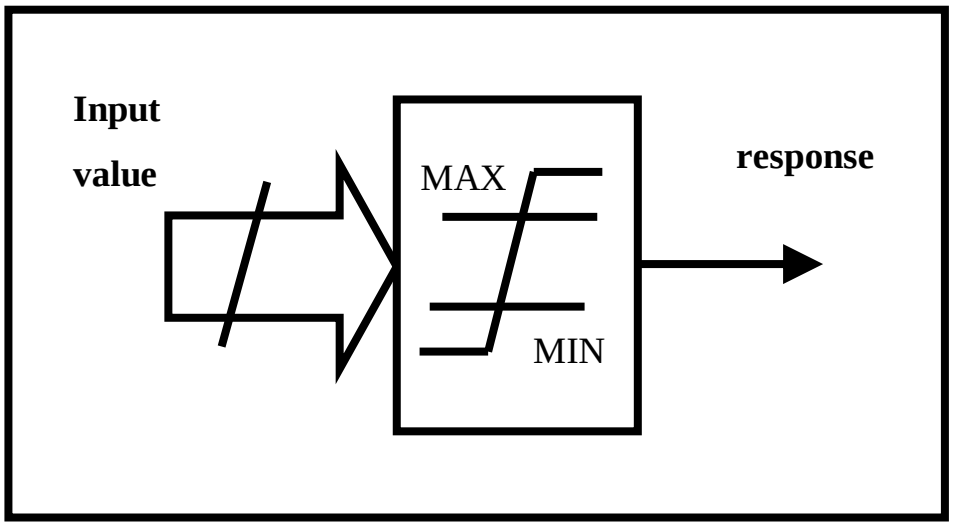

Figure (1) : Advanced RAM .

There are many different types of the digital learning networks. In this paper a single layer network with a feedback was used as shown in figure (2) . This network is composed of one layer with feedback; and number of discriminators, each discriminator contains an advanced RAM. The advanced RAM consists of two bits, the first bit is stored in the maximum value and the second bit is stored in the minimum value. Their responses are added together by a summation unit. This response is finally thresholds by a preset value. So the final response of this network is either 1 or 0.

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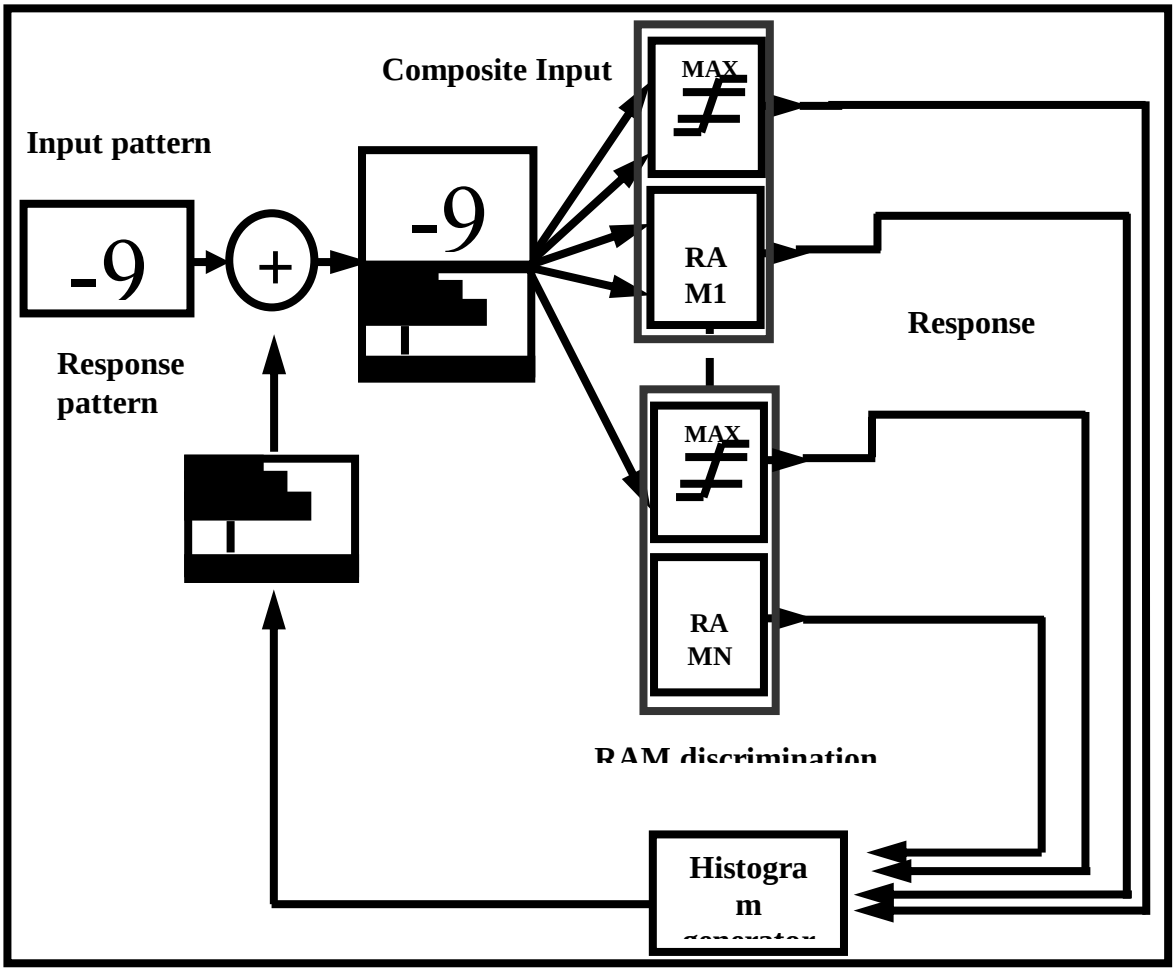


Figure (2) : Histogram Feedback Digital Learning Network using

4. The Training Phase of the System :

The training of this technique is carried out by using two sets of patterns referred to feedback of digital learning network for training sets. This phase is started by training of the feedback of digital learning network where each discriminator is trained on all the patterns of its class in the feedback of digital learning network training set.

During this process a training pattern of class i is presented to the feedback of digital learning network, taken from each n- tuple the maximum value and minimum value where saving in the two locations in the RAM and using it later in the classification stage. This technique is shown by using the flowchart of figure (3).

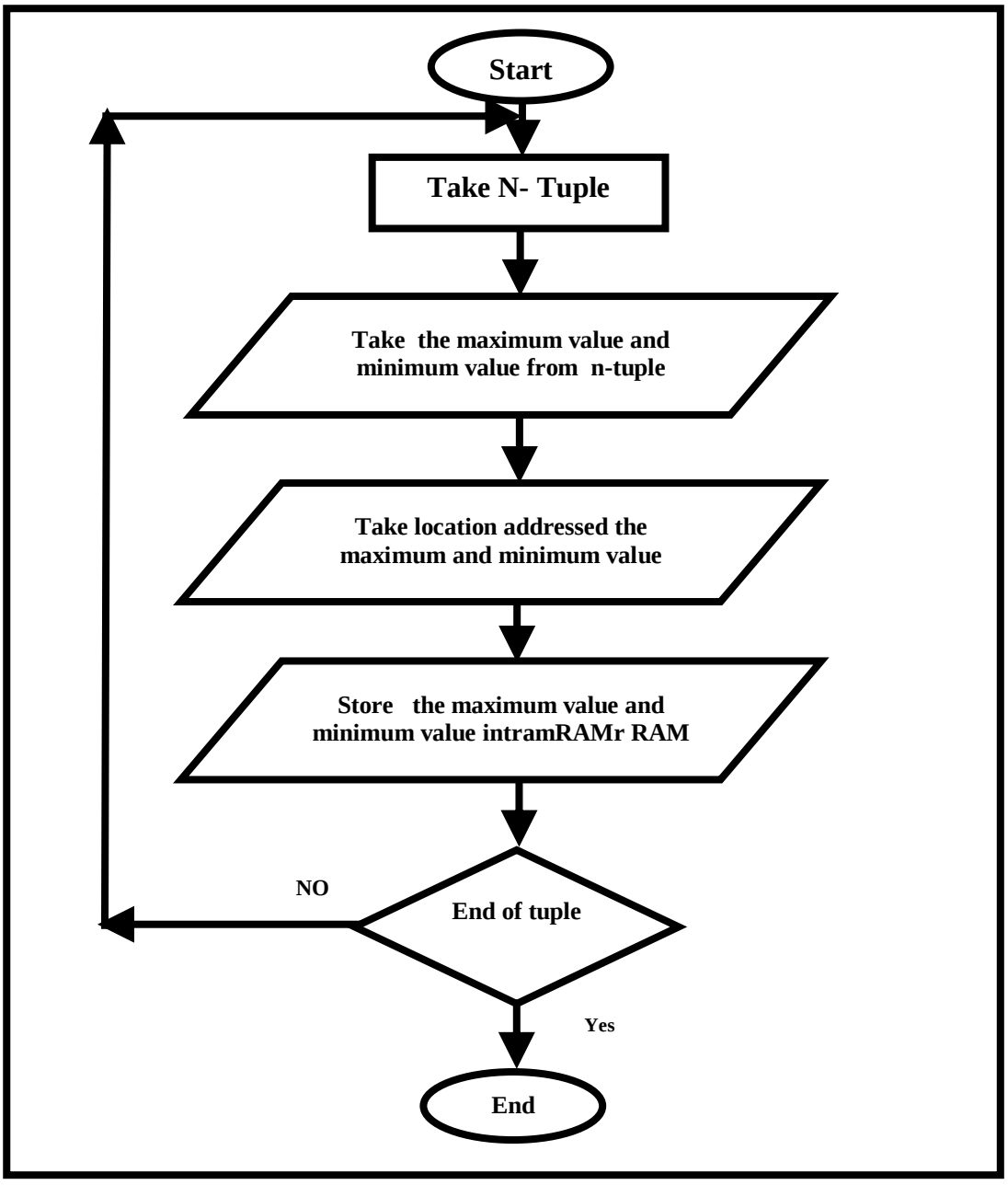


Figure (3): Flowchart of Feedback Digital Learning Network using Advanced RAM in training stage.

5. Classification Phase of the System :

During the classification phase, the image has been sampled to be classified in many random position. These samples constitute the test set.

During this phase the pixel values are summed and divided by the size of n – *tuple* . If the final result was between the maximum value and the minimum value then the RAM output will be 1, else the

output is 0. The response of the first stage of classification forms the classification histogram, that is used in the second stage of classification in feedback digital learning network. The average response in this technique is then obtained by averaging the responses over the entire test set. This technique is illustrated in figure (4).

The main advantage of the advanced RAM is that it could respond directly to multi-level value. So the feedback digital learning network with advanced RAM can be used directly in grayscale image recognition**.** This method will cover all the probabilities of the levels and will increase the generalization ability.

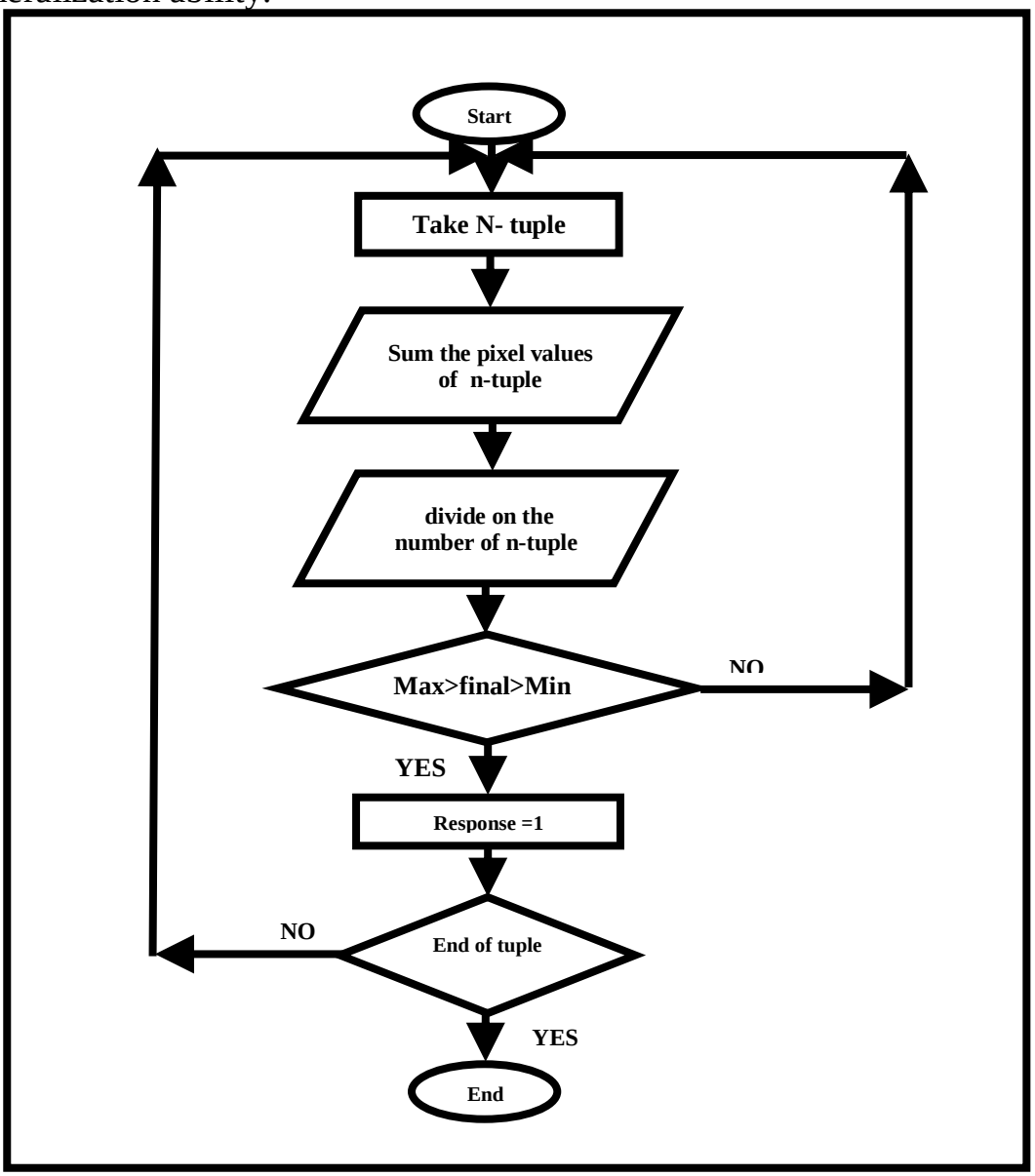


Figure (4): Flowchart of Feedback Digital Learning Network using Advanced RAM in classification stage.

6. The results:

Three experiments were implemented on the FDLNs using Advanced RAM to study the effect of this technique. In each experiment , different sizes of n such as 4, 3 and 8 have been used. For the same patterns (training, test patterns) with random mapping ,it has been found that the suggested system can correctly classify these patterns .

The results in table (1) show that the system is sensitive to the n-tuple size. These measurements of system performance, although by no means exhaustive, illustrate the care which must be adopted in the selection of the basic system parameters practical application. The results indicate that there is a considerable improvement in the recognition performance of the system. The best performance occurs at n-tuple of size 4.

The percentage of correctly classified test patterns to 92.5 %. This proves that the proposed system can improve the processor logic function (i.e. memory element content) of the system by adding more information about the distribution of features in all classes.

Table 1 : Results of FDLNs using Advanced RAM

Class set size =120, Disc. no.=10				
Feedback Digital Learning Networks using Advance RAM	***n-tuple***	***3***	***4***	***8***
	correct	**91.67 %**	**92.5 %**	**90%**
	reject	**8.33%**	**7.5%**	**3.33%**
	error	**0%**	**0%**	**6.67%**

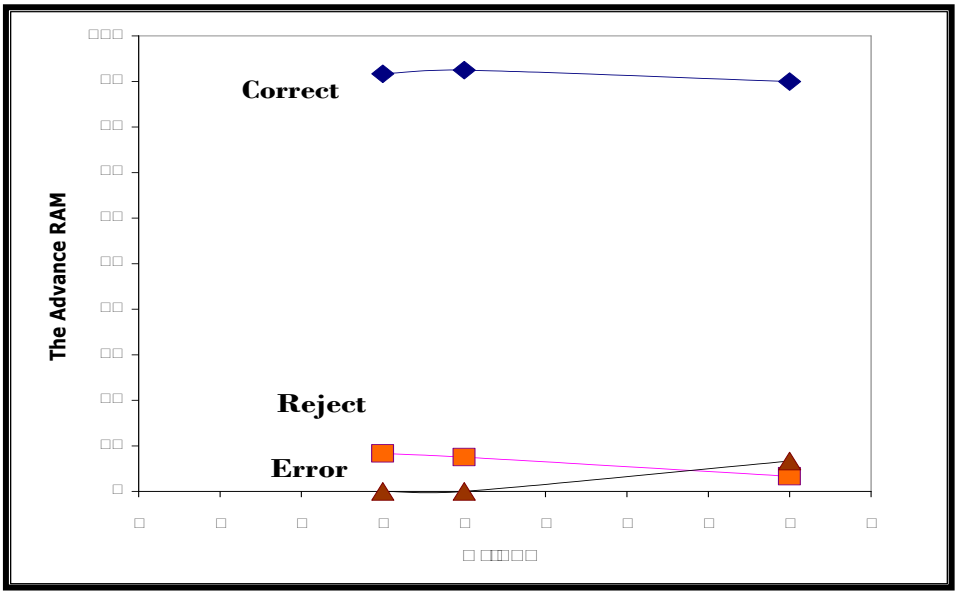
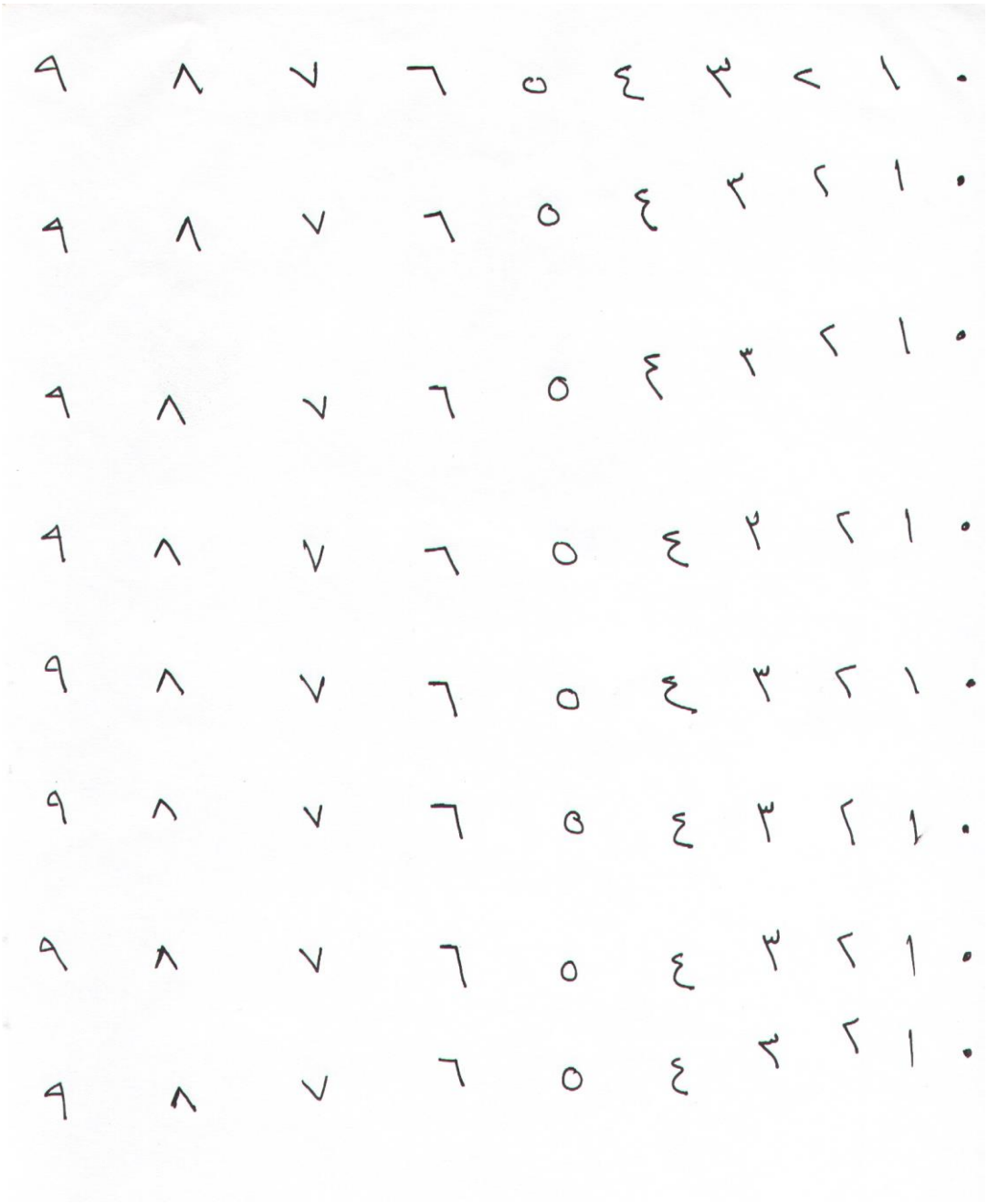


Figure (5): Classification of Advanced RAM

In figure (5), it can be seen that there is high development and enhancement in recognition performance . The **FDLNs** can increase the performance of the system and also emphases on the nature of the feature and whole range of applications, provided a high confidence in recognition, and it is so easy to implement in software and hardware.

Examples of the used Patterns



7. Conclusions:

The primary goal of this work was to investigate various techniques to improve the recognition performance of non-deterministic data by 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 advanced RAM strategy proved to be a useful approach to deal with the gray scale images faced with digital learning networks. This approach has fast training and simple hardware design facilities. Using this strategy the performance of the recognizer was increased to 92.5 % correct and the reject was decreased to 7.5 %.

8. References:

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3. Simon M. Lucas and A. Amiri, " Recognition of chain-coded handwritten characters with the scanning n-tuple classifier ", 1995.
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التغذية الرجعية في شبكة تعلم الرقمية باستخدام العناوين

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الخلاصة

تم بناء منظومة لتمييز الانماط بالاستناد الى تقنية n-tuple و استخدامها لتمييز الانماط الغير محددة مثل الارقام الهندية اليدوية . 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. النتائج التي تم الحصول عليها تبين الاداء العالي للمنظومة ونرى أن أداة التميز للمنظومة بعد إضافة الطرق الجديدة كانت جيدة وتدل على أهمية ونجاح التقنيات المضافة.