# A NOVEL METHOD FOR HANDWRITTEN DIGIT RECOGNITION

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**Paper 1:** Handwritten digit recognition by combined classifiers

**Author :** M. Breukelen; Robert P. W. Duin; David M. J. Tax; J. E. den Hartog

**Summary:**

Classifiers can be combined to reduce classification errors. We did experiments on a data set consisting of different sets of features of handwritten digits. Different types of classifiers were trained on these feature sets. The performances of these classifiers and combination rules were tested. The best results were acquired with the mean, median and product combination rules. The product was best for combining linear classifiers, the median for $k$-NN classifiers. Training a classifier on all features did not result in less errors.

**Paper 2 : A trainable feature extractor for handwritten digit recognition**

**Author:** Fabien Lauer, Ching Y. Suen, Gérard Bloch

**Summary:**

This article focuses on the problems of feature extraction and the recognition of handwritten digits. A trainable feature extractor based on the LeNet5 convolutional neural network architecture is introduced to solve the first problem in a black box scheme without prior knowledge on the data.

In order to increase the recognition rate, new training samples are generated by affine transformations and elastic distortions. Experiments are performed on the well-known MNIST database to validate the method and the results show that the system can outperform both SVMs and LeNet5 while providing performances comparable to the best performance on this database. Moreover, an analysis of the errors is conducted to discuss possible means of enhancement and their limitations.

## Paper 3 : Handwritten digit recognition by neural networks with single-layer training

**Author :** S. Knerr; L. Personnaz; G. Dreyfus

**Summary:**

It is shown that neural network classifiers with single-layer training can be applied efficiently to complex real-world classification problems such as the recognition of handwritten digits. The STEPNET procedure, which decomposes the problem into simpler subproblems which can be solved by linear separators, is introduced. Provided appropriate data representations and learning rules are used, performance comparable to that obtained by more complex networks can be achieved. Results from two different databases are presented: an European database comprising 8700 isolated digits and a zip code database from the US Postal Service comprising 9000 segmented digits. A hardware implementation of the classifier is briefly described

## Paper 4 : Handwritten digit recognition: applications of neural network chips and automatic learning.

**Author :** Y. Le Cun; L.D. Jackel; B. Boser; J.S. Denker; H.P. Graf; I. Guyon; D. Henderson; R.E. Howard; W. Hubbard

**Summary:**

Two novel methods for achieving handwritten digit recognition are described. The first method is based on a neural network chip that performs line thinning and feature extraction using local template matching. The second method is implemented on a digital signal processor and makes extensive use of constrained automatic learning. Experimental results obtained using isolated handwritten digits taken from postal zip codes, a rather difficult data set, are reported and discussed.

**Paper 5 : Hand Written Digit Recognition using Machine Learning**

**Author :** Rohan Sethi; Ila Kaushik

**Summary:**

used for the purpose of segmentation in the proposed work. SVM is applied for Hand-written character and digit recognition have been one of the most exigent and engrossing field of pattern recognition and image processing. The main aim of this paper is to demonstrate and represent the work which is related to hand-written digit recognition. The hand-written digit recognition is a very exigent task. In this recognition task, the numbers are not accurately written or scripted as they differ in shape or size; due to which the feature extraction and segmentation of hand-written numerical script is arduous. The vertical and horizontal projections methods are recognition and classification, while convex hull algorithm is applied for feature extraction.

**Paper 6 : A novel method for Handwritten Digit Recognition with Neural Networks**

**Author :** Malothu Nagu ; N Vijay Shankar ; K Annapurna

**Summary :**

Character recognition plays an important role in the modern world. It can solve more complex problems and makes humans' job easier. An example is handwritten character recognition. This is a system widely used in the world to recognize zip code or postal code for mail sorting. There are different techniques that can be used to recognize handwritten characters. Two techniques researched in this paper are Pattern Recognition and Artificial Neural Network (ANN). Both techniques are defined and different methods for each technique is also discussed. Bayesian Decision theory, Nearest Neighbour rule, and Linear Classification or Chinese Character and Handwritten Digit recognition uses Neural Network to recognize them. Neural Network is used to train and identify written digits. After training and testing, the accuracy rate reached 99%. This accuracy rate is very high.

## Paper 7 : Recognition of isolated and simply connected handwritten numerals and Pattern Recognition

**Author :** M Shridhar ; A Badreldin

**Summary :**

In this paper the authors describe the results of their investigation into the development of a recognition algorithm for identifying numerals that may be isolated or connected, broken or continuous using a structural classification scheme, the recognition algorithm is derived as a tree classifier. In an extensive test experiment, an accuracy of 99% was realized with isolated numerals. When connected numerals were also included a recognition accuracy of 93% was obtained.

## Paper 8 : An effective result-feedback neural algorithm for handwritten character recognition by International Journal Parallel and Science Computation

**Author :** Hao Y ; Shi Y ; Zhang D ; Zhu X

**Summary :**

In this paper , a new algorithm of handwritten character recognition based on result-feedback is proposed . It is designed as an effective neural network by adding confidence back-propagation and input modification . thus both pre-processing and recognition operation are closely integrated together . The convergence of the algorithm is proved and many experiments shows that the error rate in such a result-feedback neural network (RFNN) can be greatly reduced as well as the robust to environmental noise.