**A NOVEL METHOD FOR HANDWRITTEN DIGIT RECOGNITION SYSTEM**

**Abstract:**

Handwritten digit recognition has recently been of very interest among the researchers because of the evolution of various Machine Learning, Deep Learning and Computer Vision algorithms. Human can visually sense the world around them by using their eyes and brains.

Computer vision works on enabling computer and process images in the same way that human vision does. Several algorithms developed in the area of computer vision to recognise images. The goal of this work is to create a model to identify and determine the handwritten digits from its database with better accuracy and aim to complete this by using the concept of Convolutional Neural Network and MNIST dataset.

A method called soft max regression is used for assigning the probabilities that to handwritten digits. Though the goal is to create a model which can recognise the digits but can extend for letters and then a person's handwriting. Through this work, people can learn under practically apply the concept of a Convolutional Neural Networks.

**Review of Literature**

**Machine learning models for mathematical symbol recognition: A stem to stern literature analysis - Vinay Kukreja & Sakshi**

Given the ubiquity of handwriting and mathematical content in human transactions, machine recognition of handwritten mathematical text and symbols has become a domain of great practical scope and significance. Recognition of mathematical expression (ME) has remained a challenging and emerging research domain, with mathematical symbol recognition (MSR) as a requisite step in the entire recognition process.

Many variations in writing styles and existing dissimilarities among the wide range of symbols and recurring characters make the recognition tasks strenuous even for Optical Character Recognition. The past decade has witnessed the emergence of recognition techniques and the peaking interest of several researchers in this evolving domain.

In light of the current research status associated with recognizing handwritten math symbols, a systematic review of the literature seems timely. This article seeks to provide a complete systematic analysis of recognition techniques, models, datasets, sub-stages, accuracy metrics, and accuracy details in an extracted form as described in the literature.

A systematic literature review conducted in this study includes pragmatic studies until the year 2021, and the analysis reveals Support Vector Machine (SVM) to be the most dominating recognition technique and symbol recognition rate to be most frequently deployed accuracy measure and other interesting results in terms of segmentation, feature extraction and datasets involved are vividly represented.

**A Novel Method for the Recognition of Isolated Handwritten Arabic Characters - Ahmed Sahlol, Cheng Suen**

There are many difficulties facing a handwritten Arabic recognition system such as unlimited variation in human handwriting, similarities of distinct character shapes, interconnections of neighbouring characters and their position in the word. The typical Optical Character Recognition (OCR) systems are based mainly on three stages, preprocessing, features extraction and recognition.

This paper proposes new methods for handwritten Arabic character recognition which is based on novel preprocessing operations including different kinds of noise removal also different kind of features like structural, Statistical and Morphological features from the main body of the character and also from the secondary components. Evaluation of the accuracy of the selected features is made.

The system was trained and tested by back propagation neural network with CENPRMI dataset. The proposed algorithm obtained promising results as it is able to recognize 88% of our test set accurately. In Comparable with other related works we find that our result is the highest among other published works.

**A novel method for offline handwriting-based writer identification - Zhenyu He; Bin Fang; Jianwei Du; Yuan Yan Tang; Xinge You**

Handwriting-based writer identification is a hot research topic in the pattern recognition field. Nowadays, online handwriting-based writer identification is steadily growing toward its maturity. On the contrary, offline handwriting-based writer identification still remains as a challenging problem because writing features only can be extracted from the handwriting image in this situation.

As a result, plenty of dynamic writing information, which is very valuable for writer identification, is lost. At present, 2D Gabor filter method is widely acknowledged as a good method for offline handwriting identification, however it still suffers from some inherent disadvantages, such as the high computational cost.

In this paper, we present a novel wavelet-based GGD method to replace the traditional 2D Gabor filters. Shown in our experiments, this novel method not only achieves better experiment results but also greatly reduces the elapsed time on calculation.

**A Novel Method for Recognition of Persian Alphabet by Using Fuzzy Neural Network - Mohammad Mehdi Motahari Kia; Jafar A. Alzubi; Mehdi Gheisari; Xiaobo Zhang; Mohamadtaghi Rahimi; Yongrui Qin**

This paper presents a system that can recognize handwritten words expressed using broken letters of the Persian alphabet. The proposed system can be used for most activities related to the gathering of public information.

Statistical features of the separated/broken letters are employed in the system. Each letter is recognized using interconnected fuzzy neural network. The advantages of this method include high precision owing to the strength of the neural network algorithm and the possibility of extending dataset instance codes in a simple manner. At last, an evaluation for the proposed method is provided experimentally.

**A Novel Method for Persian Handwritten Digit Recognition Using Support Vector Machine - Mojtaba Mohammadpoor, Abbas Mehdizadeh, Hava Alizadeh Noghabi**

Handwritten digit recognition has got a special role in different applications in the field of digital recognition including; handwritten address detection, check, and document.

Persian handwritten digits classification has been facing difficulties due to different handwritten styles, inter-class similarities, and intra-class differences. In this paper, a novel method for detecting Persian handwritten digits is presented. In the proposed method, a combination of Histogram of Oriented Gradients (HOG), 4-side profiles of the digit image, and some horizontal and vertical samples was used and the dimension of the feature vector was reduced using Principal Component Analysis (PCA).

The proposed method applied to the HODA database, and Support Vector Machine (SVM) was used in the classification step. Results revealed that the detection accuracy of such method has 99% accuracy with an adequate rate due to existing unacceptable samples in the database, therefore, the proposed method could improve the outcomes compared to other existing methods.

**Biometric personal identification based on handwriting - Yong Zhu; Tieniu Tan; Yunhong Wang**

In this paper, we describe a new method to identify the writer of Chinese handwritten documents. There are many methods for signature verification or writer identification, but most of them require segmentation or connected component analysis. They are content dependent identification methods, as signature verification requires the writer to write the same text (e.g. his name).

In our new method, we take the handwriting as an image containing some special texture, and writer identification is regarded as texture identification. This is a content independent method. We apply the well-established 2D Gabor filtering technique to extract features of such textures and a weighted Euclidean distance classifier to fulfil the identification task. Experiments are made using Chinese handwritings from 17 different people and very promising results were achieved.

**Forensic Writer Recognition - Volker Klement**

The application of image processing and pattern recognition techniques to support the comparative handwriting analysis is reported. The dominating problem proved to be the selection and formulation of suited task-oriented features.

Adequate solutions have been obtained by heuristic approaches, they have to be verified statistically on large test data sets.

**Personal identification based on handwriting - H.E.S.Said, T.N.Tan, K.D.Baker**

Many techniques have been reported for handwriting-based writer identification. The majority of techniques assume that the written text is fixed (e.g., in signature verification).

In this paper we attempt to eliminate this assumption by presenting a novel algorithm for automatic text-independent writer identification. Given that the handwriting of different people is often visually distinctive, we take a global approach based on texture analysis, where each writer's handwriting is regarded as a different texture.

In principle, this allows us to apply any standard texture recognition algorithm for the task (e.g., the multi-channel Gabor filtering technique). Results of 96.0% accuracy on the classification of 1000 test documents from 40 writers are very promising. The method is shown to be robust to noise and contents

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