# A Novel Method for Handwritten Digit Recognition System

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## Introduction:

Handwriting recognition (HWR) is the ability of a computer to receive and interpret intelligible handwritten input from sources such as paper documents, photographs, touch-screens and other devices. One of the means of identifying an individual is through his/her handwriting pattern, since there exists a certain degree of stability in the pattern of an individual's writing style, by which it is possible to identify the author. Here the input will be given as an image of the handwritten text. The image of the written text may be sensed "off line" from a piece of paper by optical scanning (optical character recognition) or intelligent word recognition. Alternatively the movements of the pen tip may be sensed "on line", for example by a pen-based computer screen surface, a generally easier task as there are more clues available.

The purpose of preprocessing is to discard irrelevant information in the input data, that can negatively affect the recognition. The second step is feature extraction. Out of the two- or more-dimensional vector field received from the preprocessing algorithms, higher-dimensional data is extracted. The purpose of the third step is to highlight important information for the recognition model.

## Literature Survey:

- **A novel method for Handwritten Digit Recognition with Neural Networks**

  - MALOTHU NAGU,N VIJAY SHANKAR , K.ANNAPURNA.

The advance of handwriting processing results from a combination of various elements, for example: improvements in the recognition rates, the use of complex systems to integrate various kinds of information, and new technologies such as high quality high speed scanners and cheaper and more powerful CPUs.

This can be done either by controlling a mouse or using a third-party drawing tablet. The input can be converted into typed text or can be left as an "ink object" in our own handwriting. We can also enter the text we would like the system to recognize into any Microsoft Office program file by typing. We can do this by typing 1s and 0s. This works as a Boolean variable.

- **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 handwriting styles, inter-class similarities, and intra-class differences.

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 a 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.

- **Handwriting Recognition using Machine Learning**
  - **Anil Chandra Naidu Matcha.**

Optical Character Recognition(OCR) market size is expected to be USD 13.38 billion by 2025 with a year on year growth of 13.7 %. This growth is driven by rapid digitization of business processes using OCR to reduce their labor costs and to save precious man hours.

The high variance in handwriting styles across people and poor quality of the handwritten text compared to printed text pose significant hurdles in converting it to machine readable text. Nevertheless it's a crucial problem to solve for multiple industries like healthcare, insurance and banking.

- **Survey on Recurrent Neural Network in Natural Language Processing**
  - **Kanchan M. Tarwani, Swathi Edem.**

Natural Language Processing(NLP) is a way for computers to analyze, understand, and derive meaning from human language in a smarter way. Recurrent neural networks (RNN) have revolutionized the field of NLP. RNNs are used as modeling units in sequence.

Natural Language Processing is a field that covers computer understanding and manipulation of human language and it’s ripe with possibilities for gathering information and news. By utilizing NLP, developers can organize and structure knowledge to perform various tasks such as automatic summarization, translation, named entity recognition, relationship extraction, semantic analysis, sentiment analysis, speech recognition, and topic segmentation.

- **Handwritten Text Recognition using Deep Learning .**
  - **Batuhan Balci, Dan Saadati, Dan Shiferaw.**

Despite the abundance of technological writing tools, many people still choose to take their notes traditionally: with pen and paper. However, there are drawbacks to handwriting text. It's difficult to store and access physical documents in an efficient manner, search through them efficiently and to share them with others.

Thus, a lot of important knowledge gets lost or does not get reviewed because of the fact that documents never get transferred to digital format. We have thus decided to tackle this problem in our project because we believe the significantly greater ease of management of digital text compared to written text will help people more effectively access, search, share, and analyze their records, while still allowing them to use their preferred writing method.

- **Construction of Statistical SVM based Recognition Model for Handwritten Character Recognition .**

**-Yasir Babiker Hamdan,Prof. Sathish.**

There are many applications of the handwritten character recognition (HCR) approach still exist. Reading postal addresses in various states contains different languages in any union government like India. Bank check amounts and signature verification is one of the important applications of HCR in the automatic banking system in all developed countries.

The main aim of this research article is to provide the solution for various handwriting recognition approaches such as touch input from the mobile screen and picture file. The recognition approaches perform with various methods that we have chosen in artificial neural networks and statistical methods and so on and to address nonlinearly divisible issues.

- **Gujarati Handwritten Character Recognition from Text Images**

**- Dimple Singhania**

**oday is the era of paperless office and governance. It comes with numerous advantages like increased productivity and efficiency, pervasiveness, storage optimization, robustness and eco-friendliness. Hence there is a need of converting paper documents into machine editable form. This leads to development of OCR (Optical Character Recognition).**

**OCR is a technique to convert, mechanically or electronically an image, photo or scanned document of a handwritten text (HCR-Handwritten Character Recognition) or printed text (PCR- Printed Character Recognition) into digital text.**

- **A Novel Approach of Handwritten Character Recognition using Positional Feature Extraction**

**-Swapnil A. Vaidya, Balaji R. Bombade**

Character recognition has always been an active field of research for computer scientists worldwide due to its useful real life applications such as automatic data entry, mail processing, form processing and many other similar situations.

The study investigates the direction of the CR research, analyzing the limitations of methodologies for the systems, which can be classified based upon two major criteria: the data acquisition process (on-line or off-line) and the text type (machine-printed or hand written) .

- **A Survey of Handwritten Character Recognition with MNIST and EMNIST**

**-Alejandro Baldominos , Yago Saez and Ped.**

This paper summarizes the top state-of-the-art contributions reported on the MNIST dataset for handwritten digit recognition. This dataset has been extensively used to validate novel techniques in computer vision, and in recent years, many authors have explored the performance of convolutional neural networks (CNNs) and other deep learning techniques over this dataset.

To the best of our knowledge, this paper is the first exhaustive and updated review of this dataset; there are some online rankings, but they are outdated, and most published papers survey only closely related works, omitting most of the literature. This paper makes a distinction between those works using some kind of data augmentation and works using the original dataset out-of-the-box.

- **Novel Approach for Character Recognition Using Chi-Square**
  - **Sai Rama Krishna Indarapu, Narasimha Reddy Soora, Mohammed Sharfuddin Waseem & Mohammed Ehsan Ur Rahman .**

One of the most amazing outcomes of image processing being optical character recognition (OCR) plays a key role in various applications such as automated processing of documents, auto-evaluation of answer sheets.

Multilingual character recognition is a very challenging area in OCR, because of the complex shape of various characters. In this paper, we propose an extended shadow feature extraction technique along with shadow features which has the capability to extract the complex structure of most of the multilingual characters and these features can ease the functioning of the multilingual OCR.

- **A Novel Approach to Recognition of English Characters Using Artificial Neural Network**
  - **Prerna Kakkar, Umesh Dutta .**

Character recognition is a process which associates a symbolic meaning with objects (letter, symbols & numbers) drawn on an image. Character recognition can be online or offline. Online character recognition has real time contextual information while offline character recognition systems operate in non real time.

Optical character recognition (OCR) and magnetic character recognition (MCR) methods are most widely used for the recognition of characters or patterns. OCR uses optical means to acquire the character typically using a camera or optical scanner. Here the characters are in the form of pixel images and it could be either hand written or printed, of any size, shape or orientation.

# Existing System:

Handwriting recognition has been one of the most fascinating and challenging research areas in the field of image processing and pattern recognition in recent years. It contributes immensely to the advancement of an automation process and can improve the interface between man and machine in numerous applications. Local Binary Pattern (LBP) is used for texture description. It is the binary descriptor to recognize the text from images.

The features of the characters that are crucial for classifying them at the recognition stage are extracted. This is an important stage as its effective functioning improves the recognition rate and reduces the misclassification .Features are extracted based on global and local features. Gray level co-occurrence matrix and Wavelet features are extracted from the printed documents.

**Development:**

HandWritten Recognition using Optical Character Recognition (OCR).Handwriting recognition is one of the compelling research works going on because every individual in this world has their own style of writing. It is the capability of the computer to identify and understand handwritten digits or characters automatically. Because of the progress in the field of science and technology, everything is being digitized to reduce human effort. Hence, there comes a need for handwritten digit recognition in many real-time applications. The MNIST data set is widely used for this recognition process and it has 70000 handwritten digits. We use Artificial neural networks to train these images and build a deep learning model. Web application is created where the user can upload an image of a handwritten digit. this image is analyzed by the model and the detected result is returned on to UI

## Conclusion :

All the existing projects are exceptional in their perspectives. But the existing projects are not sufficient in recognizing every hand written text .In our proposed system we overcome that by the support of tools like CNN,IBM Watson and technology like Keras capabilities for better predicting. Our project would be easier to handle and for good UI response .

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