

---

# Managing the Offline Text Recognition Accuracy Using Recurrent Neural Network

---

**D. Palanikkumar<sup>1</sup>, Abhisek Sethy<sup>2</sup>, Kasiprasad Mannepalli<sup>3</sup>, P. John Augustine<sup>4</sup>,  
Semira Abdela Seyid<sup>5</sup>, Adem Aman Hassen<sup>6</sup>**

<sup>1</sup>Professor, Department of IT, Dr NGP Institute of Technology, Coimbatore, India.

<sup>2</sup>Assistant Professor, Department of Information Technology, GMR Institute of Technology,  
Rajam, Andhra Pradesh, India.

<sup>3</sup>Associate Professor, Department of ECE, K L Deemed to be University, Vaddeswaram,  
Guntur, Vijayawada, Andhra Pradesh, India.

<sup>4</sup>Associate Professor, Department of Computer Science and Engineering, Sri Eshwar College  
of Engineering, Coimbatore, Tamil Nadu, India.

<sup>5</sup>Lecturer, Department of Mechanical Engineering, Dambi Dollo University, Dambi Dollo,  
Oromia Region, Ethiopia.

<sup>6</sup>Department of Mathematics, College of Natural and Computational Science, Dambi Dollo  
University, Dambi Dollo, Oromia Region, Ethiopia.

palanikkumard@gmail.com<sup>1</sup>, abhisek052@gmail.com<sup>2</sup>, mkasiprasad@gmail.com<sup>3</sup>,  
pjohnaugustine@gmail.com<sup>4</sup>, semiraabdela973@gmail.com, adeeman017@gmail.com<sup>6</sup>

## **Abstract:**

*Much traditional software is available for recognising the handwritten characters or digits and that gets converted to the digital format. But the accuracy level and performance of the systems are not that much acceptable due to lack of temporal information. In this proposed method the training set is created with the strokes and segments of the characters and the digits and that get matched with the test data. The segmentation is based on position of character, order of writing the character, writing time and writing pressure. A mathematical model is created with a support vector function to perform the identification. The stroke and segment extraction makes the accuracy more in this system. The aim is to build a model for managing handwritten text recognition accuracy and translate them into speech. This problem is approached using Recurrent Neural Network.*

**Keywords:** Text Recognition, Accuracy, Neural Network

## **1. INTRODUCTION**

Handwritten materials are becoming less importance in this digital world. It is very difficult for the physical data to store, access and process in efficient manner. It needs to be manually updated and labor is required to maintain and organize. So in traditional methods encountering of loss of data occurs. So the technology is very much needed in order to

convert all the handwritten materials into a digital one. So that people makes easier to access and manipulate the text. Furthermore storing handwritten materials into a digital form makes the data more secure. Handwriting Detection is a technique or the ability of software to recognize and translate handwritten characters or the digits in paper to a digital form.

The commonly used method to recognize handwritten inputs are Intelligent Word Recognition Optical Character Recognition, Database which consists of samples known authorship Identification System Writer, digital way of recognizing knows as digital ink etc., which converts automatically the handwritten inputs to a digital form by computer enable text processing software applications.

The interface commonly used to identify online handwritten inputs is a digital pen by which the user writes with it, a touch platform to an output display which is very sensitive, a software system application which recognizes the movements of the pen across the sensitive writing surface to a digital text and by using some of the text processing applications to convert the text present in the image to a digital form.

The strategies of recognition depend much on the data. It must be linked together even if it is poorly written or complex. So the individual word should be isolated to make the identification easy.

## 2. TECHNIQUES INVOLVED:

Based on the way of type of pre processing techniques of the data by decision tree algorithm the Character Recognition techniques can be classified into two criteria: Global transforms and Decision methods.

**2.1 Global transforms** include correlation, Fourier descriptors, strokes, loops, openings, diacritical marks, skeleton, etc.

**2.1 Decision methods** include statistical methods, neural networks, structural matching and stochastic processing

The organization of this paper follows as:

- i) Comparison Analysis of various methods.
- ii) Methodology used in identifying character recognition
- iii) Results

### *Comparison Analysis:*

S.No	Author	Method	Classifier	Accuracy(%)
1.	[2]	Support vector machine	Neural Network	98.86(training)
				62.93(test)
2.	[3]	LetNet 5	Convolutional neural network	93.7(upper case)
				90.2(lower case)
3.	[1]	Hybrid feature extraction	Feed Forward	95.96
			NN Radial	93.82

			base function	
			NN Nearest Neighbour	91.88
4.	[4]	Geometry extraction	Geometric Density	77.89
			Geometric feature	76.44
5.	[5]	Local and Global feature extraction	HMM	98.26
6.	[6]	Row wise segmentation Single	ANN	80
7.	[7]	Direction element feature Correcting Assignment	Algo	99.03
8.	[8]	Ecludian distance	ANN	92.31
9.	[9]	Surface mount technology	BP neural network	98.6
10.	[10]	Particle swarm method PSO-BP	neural network	86.8(capital)
			network	85.3(small)
11.	[11]	Hyperline segment	FHLSSN	72.1
			MFHLSSN	72.55

Table 1:Comparion Analysis of Character Recognition

### 3. METHODOLOGY:

Offline Handwritten Text Recognition (HTR) which translates hand wrote text from scanned images to digital text. The images are then trained by Neural Network. In this method the words are considered as a smaller unit size for easy recognize of the system which then relates to the characters.

#### 3.1 Convolution Layer:

The convolution Layer filters an input image and gives the activation as a result. Feature map occurs by repeatedly applying the process which in turn gives the location as well as the strength of the featured input image. The convolution layer filters a large number of training raining dataset automatically.

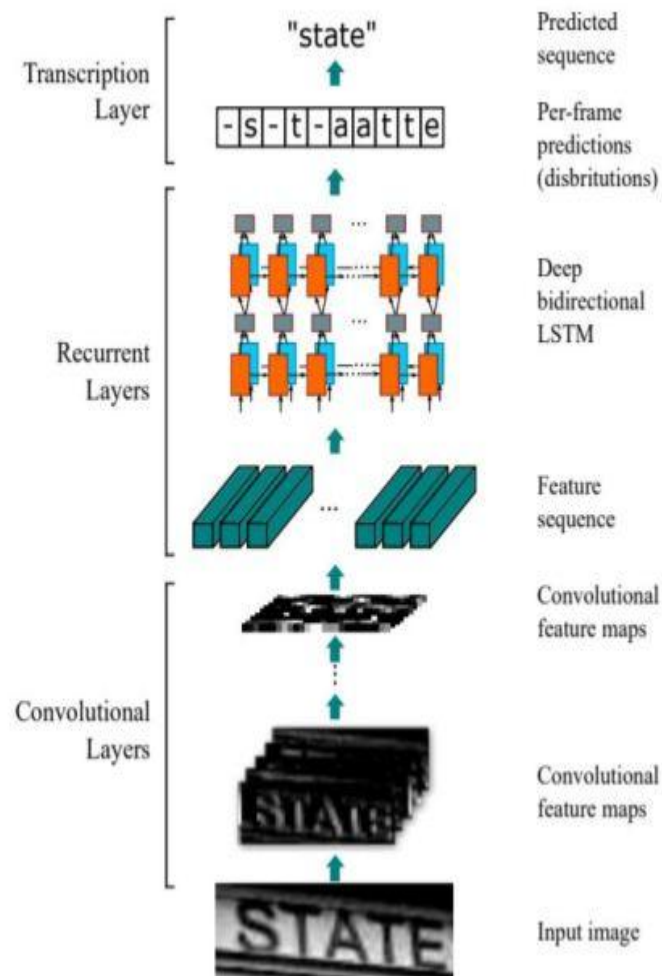


Figure 1: Identification of Offline characters

Such type of learning method predicts the model in the problem like image classification as a result the specific features are detected anywhere in the input images.

There are two types of layer available Feature learning and Classification.

In Feature Learning,

- Convolution and ReLu filters the input image and identifies the pixels sizes and its relationships.
- Strides, identifies the number of pixel over the input images
- Padding, when the filter does not perfectly fit into the input image padding process applied with zero padding and valid padding
- ReLu (Non-Linearity), To learn the non negative linear values.
- Pooling Layer, reduces the parameters if image is large.
- Fully connected Layer flattens the input matrix into vector
- Logistic regression and cost functions are used to classifying the image.

In Classification,

Classification is the decision making part of the system. Here the extracted images in the Feature Learning are considered for further process. The quality of the processed input image is further enhanced here. There are four different types of classification methods available.

- Template Matching, the degree of similarities between the two vectors are identified
- Statistical Techniques extract the set of features.
- Structural Techniques, description of complex pattern into a simpler pattern in recursive form.
- Neural Networks, massive unit of parallel interconnection in adaptive neural processors

### 3.2 Recurrent Layer:

In recurrent layer the connections between nodes forms a directed graph with temporal sequence. The dynamic behavior of the temporal sequence is exhibited here. RNN Process the internal state to a sequence of the inputs. This makes the unsegmented to a meaning full one. **Elman networks and Jordan networks and Continuous-time variants** are more powerful. The processed input images are again filtered using these variants.

In Elman networks and Jordan networks

Elman networks

$$\mathbf{h}_t = \sigma_h(\mathbf{W}_h \mathbf{x}_t + \mathbf{U}_h \mathbf{h}_{t-1} + \mathbf{b}_h)$$

$$\mathbf{y}_t = \sigma_y(\mathbf{W}_y \mathbf{h}_t + \mathbf{b}_y)$$

Jordan networks

$$\mathbf{h}_t = \sigma_h(\mathbf{W}_h \mathbf{x}_t + \mathbf{U}_h \mathbf{y}_{t-1} + \mathbf{b}_h)$$

$$\mathbf{y}_t = \sigma_y(\mathbf{W}_y \mathbf{h}_t + \mathbf{b}_y)$$

Variables and functions

$\mathbf{x}_t$ : input vector

$\mathbf{h}_t$ : hidden layer vector

$\mathbf{y}_t$ : output vector

W, U and b: parameter matrices and vector

$\sigma_h, \sigma_y$  : **Activation function**

**Continuous-time**

$$\mathbf{T}_i \mathbf{y}_i = -\mathbf{y}_i + \sum_{j=1}^n (\mathbf{w}_{ji} \sigma(\mathbf{y}_j - \theta_j)) + \mathbf{I}_i(\mathbf{t})$$

Where:

$\mathbf{y}_i$  is the Activation of postsynaptic node

$\mathbf{T}_i$  Time constant of postsynaptic node

$\sigma_x$  is the Sigmoid of x

$\mathbf{y}_j$  is the Activation of presynaptic node

$\mathbf{w}_{ji}$  is the connection weight from pre to postsynaptic node

$(\mathbf{I}_i(\mathbf{t}))$  is the Input to node

$\theta_j$  is the Bias of presynaptic node

### 3.3 Transcription Layers

The sequence is predicted here in the transcription layer. The variant function determines the input character to a digital form.

## 4. RESULTS:

The recognition system which consists of Elman Jordan network and Continuous-time variant gives the high accuracy of the results.

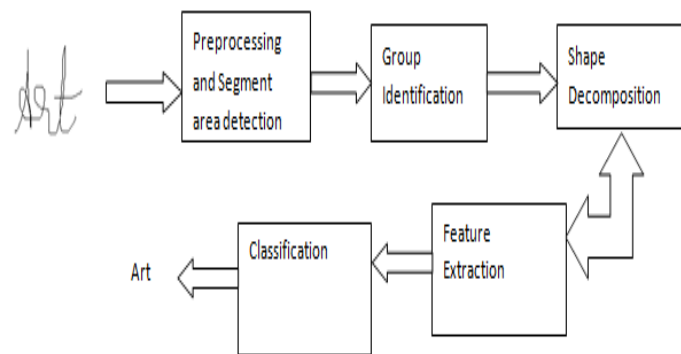


Figure 2: Processing of offline character recognition using Elman Jordan network and Continuous-time variant

## 5. CONCLUSION:

In this research work, the framework of word segmentation for offline handwritten text scripting paradigms performs the preprocessing of input text into a different layer of recurrent neural network. The proposed work identifies and works with binary quadratic problem and methodologies in structural learning. Therefore the designed model identifies the offline text into a separators of word and finally given as a digital form of text and clearly predicts the performance of the proposed work.

## 6. REFERENCES:

- [1] X. Ao, X. Zhang, H. Yang, F. Yin and C. Liu, "Cross-Modal Prototype Learning for Zero-Shot Handwriting Recognition," 2019 International Conference on Document Analysis and Recognition (ICDAR), Sydney, Australia, 2019, pp. 589-594, doi: 10.1109/ICDAR.2019.00100.
- [2] J.Pradeep, E.Srinivasan, S.Himawathi, "Performance analysis of hybrid feature extraction technique for recognizing english handwritten character",978-1- 4673-4805-8/12/2012IEEE.
- [3] Kousik, N., Natarajan, Y., Raja, R. A., Kallam, S., Patan, R., & Gandomi, A. H. (2020). Improved Salient Object Detection Using Hybrid Convolution Recurrent Neural Network, Expert Systems with Applications, Vol 166, 114064, 2021.
- [4] Aiquan yuan, Gang Bai, Lijing Jiao, Yajie Liu,"Offline handwritten english character recognition based on convolution neural network, 2012, 10th IAPR International workshop on document analysis system."

- [5] M. Rajalakshmi, P. Saranya and P. Shanmugavadivu, "Pattern Recognition-Recognition of Handwritten Document Using Convolutional Neural Networks," 2019 IEEE International Conference on Intelligent Techniques in Control, Optimization and Signal Processing (INCOS), Tamilnadu, India, 2019, pp. 1-7, doi: 10.1109/INCOS45849.2019.8951342
- [6] V. A. Naik and A. A. Desai, "Online handwritten Gujarati character recognition using SVM, MLP, and K-NN," 2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Delhi, 2017, pp. 1-6,doi: 10.1109/ICCCNT.2017.8203926.
- [7] Rakesh Kumar Mandal, N R Manna," Handwritten english character recognition using rowwise segmentation techniques," ISDMISC 2011 By IJCA.
- [8] Huiqin Lin, Wennuan Ou,Tanglin Zhu,"The research of algorithm for handwritten charcter recognition in correcting assignment system,"
- [9] D. K. Patel, T. Som and M. K. Singh, "Multiresolution technique to handwritten English character recognition using learning rule and Euclidean distance metric," 2013 International Conference On Signal Processing and Communication (ICSC), Noida, India, 2013, pp. 207-212, doi: 10.1109/ICSPCom.2013.6719784.
- [10] P. V. Bhagyasree, A. James and C. Saravanan, "A Proposed Framework for Recognition of Handwritten Cursive English Characters using DAG-CNN," 2019 1st International Conference on Innovations in Information and Communication Technology (ICIICT), CHENNAI, India, 2019, pp. 1-4, doi: 10.1109/ICIICT1.2019.8741412.
- [11] Peng Xu," Research of standard and handwritten english letter recognition system based on the PSOBP neural network," IEEE, 2011.