Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

78

Segmented And Segmentation Free Approach for Handwritten Text Recognition

Riddhi Kundal

Bhakt Kavi Narsinh Mehta university - Junagadh

Gujarat - India

Dr. Bhagavati Parekh

Bhakt Kavi Narsinh Mehta university - Junagadh

Gujarat - India

Abstract:

Text has a long history that dates back thousands of years. In a wide range of vision-based application scenarios, the rich and accurate semantic information carried by text is crucial. As a result, computer vision and pattern recognition researchers have been working on text detection in natural settings.With the growth and development of deep learning in recent years, many techniques have demonstrated promise in terms of originality, viability, and efficiency.In this paper Authors discuss the approach on handwritten text recognition (HTR) with segmentation and without segmentation.For those working in the field of computer vision's text-based picture segmentation, this paper serves as a reference.There are various methods available for segmentation like Histogram , Projection methods. Segmentation is done on 3 levels as lines, word and character. There are also some methods available which do not need segmentation for HTR as well word spotting. These segmentation free methods use different neural network algorithms like CNN, RNN, ANN etc.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

Keywords: HTR (HandWritten Text Recognition, CNN (Convolutional Neural Network), RNN (Recurrent Neural Network), ANN (Artificial Neural Network)

Introduction:

The office and government of today are paperless. Many benefits include improved productivity and efficiency, ubiquity, storage optimisation, resilience, and environmental friendliness.As a result, paper documents must be transformed into electronically editable format.An image, photo, or scanned document that contains handwritten text (HCR-Handwritten Character Recognition) or printed text (PCR-Printed Character Recognition) can be converted into digital text using OCR (Optical Character Recognition).Because to the variety of human writing styles, character size, curvature, strokes, and thickness, HCR is more difficult than PCR. There is a need to digitise answer sheets, books, and papers for every language in a country like India where many languages are spoken and many different scripts are used. There are many systems available which can automatically convert the handwritten or printed text into digital format. Handwritten text is of two types Online and Offline. Both handwritten and printed documents can be recognised offline. In offline mode, characters are written on paper and scanned or photographed using a high-resolution camera; in online mode, character pixel values are recorded by cursor, pen, or stylus movement. To Recognise any handwritten or printed text there are two ways to perform recognition. The first is with image segmentation and the other is without image segmentation.

Handwritten Text Recognition with Segmentation:

Most of the HTR models follow image segmentation methods. The most used technique for handwritten text recognition is OCR. OCR is the most popular technique in digital Image processing. Following figure shows the process of OCR.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

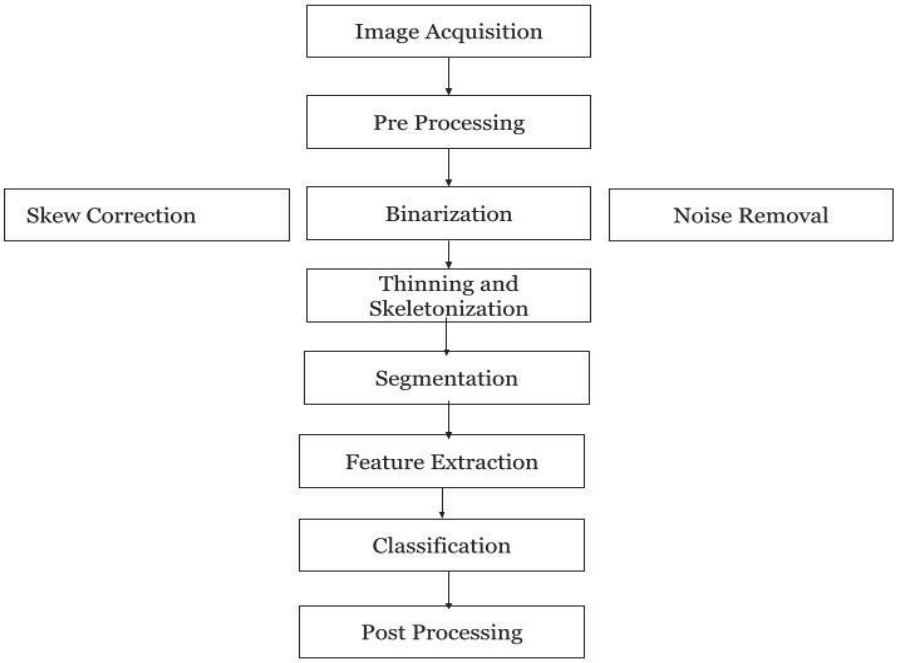

Fig. - 1 OCR Process

The main part of the OCR process is segmentation. For additional image analysis, segmentation is the process of dividing a digital image into various parts and removing significant regions known as Regions of Interest (ROI). Since handwritten characters commonly cross each other, segmentation is necessary. Several characters in Indian script may have modifiers. Identifying modifiers is the most crucial part of the segmentation process. Normal process of segmentation is Line Segmentation, Word Segmentation and Character Segmentation. There are various segmentation methods which are used for different languages like pixel counting approach, Histogram approach, Y- Histogram Projection, Text line separation, False Line Exclusion, Line region recovery, Smearing Approach, Stochastic Approach, Waterfall approach [1].

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

Table - 1 Various Segmentation methods for handwritten text recognition

Author	Segmentation Method Algorithm	Advantage	Limitations
Chhaya Patel and Apurva Desai	Projection (Devanagari, Bangla, Gurumukhi, Gujarati)	In scripts like Devanagari, Bangla, and Gurumukhi, the existence of a header line, or shirolekha, makes it easier to identify the header line because it causes a noticeable peak to appear in the word's horizontal projection profile.	Projection of the language which does not have shirolekha is not useful to detect the upper Zone boundary especially in the cases where the number of modifiers is significantly large
Aurelie Lemaitre	Delaunay graph (English)	An advantage of Delaunay graph is independent of the order the points are processed	TIN models are less widely available than raster surface models and are more time consuming to construct and process –it is a highly complex data structure.
A. Nicolaoul and B. Gatos, n. Tripathy and u. Pal	Smearing methods (English, Hindi)	It is more efficient for printed document	If gape between two words is increase not segment properly
Aurelie Lemaitre	Kalman Filter (English)	The main advantage of the Kalman filter is its ability to provide the quality of the estimate (i.e., the variance), and its relatively low complexity.	It provides accurate results only for Gaussian and linear models. For Gaussian models with limited nonlinearity, extended Kalman filter (EKF) is appropriate. For non-Gaussian and non-linear models, particle filtering (PF) is the most appropriate approach, since it is able to provide arbitrarily Posterior

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

			probability distribution.
Aurelie Lemaitre	DMOS-P (Description & Modification of The Segmentation with Perception Vision) (English)	It uses EPF (enhanced position formalism) language which enables logical description of the structure of document. This method is generic and can be applied on any kind of document.	
Naresh kumar garg alt	MLP (multi-layered perceptron)	Neural networks have the ability to generalise, which means they may group an unknown pattern with other known patterns that have similar distinctive characteristics. Due to their similarities to clean and complete inputs, noisy or incomplete inputs will be categorised.	The multilayer perceptron can occasionally end up at one of the local minima rather than the global minimum of the energy surface. This is a result of the gradient descent methodology used. There are several different strategies that can be used to lessen this likelihood.
Salama Brook And Zaher Al Aghbari	Histogram Projection (Arabic)	It can be used in many different situations to offer an insightful look at frequency distribution	It is indiscriminate. It may increase the contrast of background noise while decreasing the usable signal

Challenges of Segmentation:

The segmentation process runs into a lot of difficulties. A drop in segmentation rate and, thus, recognition rate, can be caused by badly written material. This can be divided into 2 categories 1. The problem that can be avoided. 2. The problem that can not be avoided. Because of the writer's natural way of writing the text some problems can not be avoided. The issues that can be prevented are brought on by poor material quality, inaccurate scanning, and writing speed, which is the most crucial element.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

Handwritten Text Recognition Without Segmentation:

The development of Deep Neural Networks has greatly advanced the field of HTR.As opposed to hand-crafted features and algorithms, neural networks have made it possible for algorithm writers to rely more and more on features and algorithms learnt from data. This enables developing HTR models for new datasets and languages simpler than ever before. Following Figure Fig - 2 shows the generalised architecture of HTR without Segmentation.

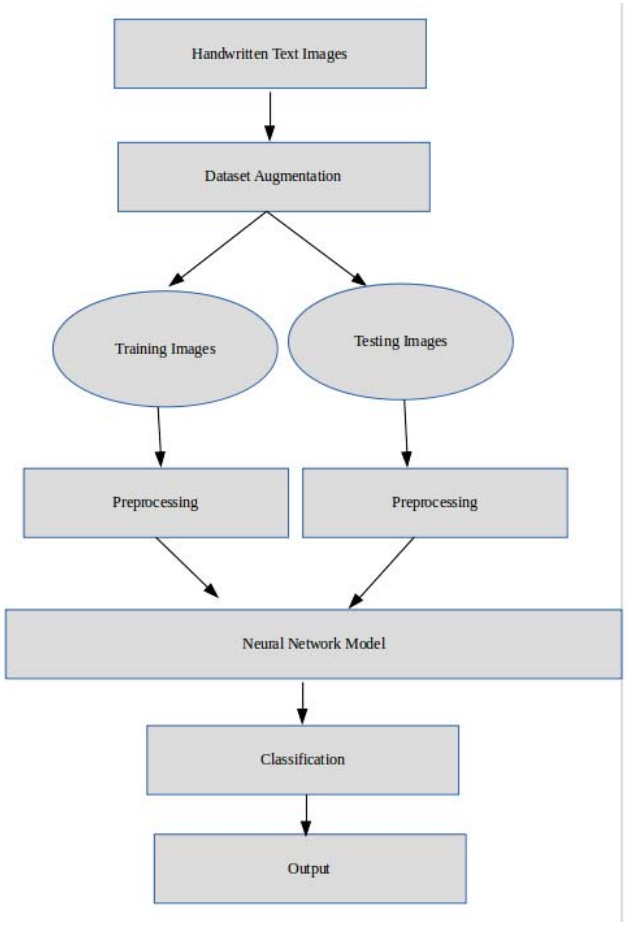

Fig - 2 Architecture of Segmentation Free HTR

Following table summarises the different methods used by various authors for HTR without using image segmentation.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

Authors	Algorithm	Advantages	Limitations	Language
Andreas Fischer, Andreas Keller, Volkmar Frinken, Horst Bunke	HMM	Spot arbitrary keywords that are not required to be known at training stage; it is not dependent on a segmentation of text lines into words	Require a set of transcribed text line images for training	English
Praveen Krishnan and C.V. Jawahar	CNN	Does not require accurate segmentation of the documents	Poor performance of matching mathematical expression and graphics	English
Sumeet S. Singh and Sergey Karayev	CNN	Full page handwriting recognition without image segmentation	Need to transcribe longer lengths of text	English, Chemistry
Konstantinos Zagoris 1, Angelos Amanatiadis and Ioannis Pratikakis	QNN	Decrease the retrieval time and overall memory and storage requirements without performance loss		English, German, Finnish, Greek
Anders Hast, Alicia Fornes	HOG, SVM, NNS	Totally deterministic & will give the same result in each run	Confusion between similar words	English
G. Khaissidi, Y. Elfakir, M. Mrabti, Z. Lakhliai, D. Chenouni, M. El yacoubi	HOG, SVM	Descriptors reduce the size of the descriptors provides better performance in time of descriptor computation	Cost of re-computing the descriptors of every image with every new query.	Arabic
Ronaldo Messina,	LSTM-RNN	Works without segmentation the line	numerical underflow that could occur if the	Chinees

Jerome Louradour		in terms of character	probabilities were uniformly spread over too many character classes.	

Conclusion:

The work performed as discussed in the paper brings a conclusion that the algorithms that should be used for handwritten text document images differ greatly. In this paper authors analysed most of the work which use segmentation methods and segmentation free methods for Handwritten text recognition. In the segmentation method it relies on the style of writing, curves, joint characters etc. And sometimes for this reason this method gets error prone. In recent days with the benediction of neural network text recognition is possible without segmentation. Various algorithms like ANN, CNN, RNN, NNS, HMM provide hidden layers which can recognise the text without line segmentation in terms of characters. All these methods can work with various languages. But still a lot of work has to be done specially for regional languages.

References:

1. Dave, N. (2015). Segmentation methods for handwritten character recognition. *International journal of signal processing, image processing and pattern recognition*, *8*(4), 155-164.
2. Fischer, A., Keller, A., Frinken, V., & Bunke, H. (2012). Lexicon-free handwritten word spotting using character HMMs. *Pattern recognition letters*, *33*(7), 934-942.
3. Patel, C., & Desai, A. (2013). Extraction of characters and modifiers from handwritten Gujarati words. *International Journal of Computer Applications*, *73*(3).
4. Lemaitre, A., Camillerapp, J., & Coüasnon, B. (2011, January). A perceptive method for handwritten text segmentation. In *Document recognition and retrieval XVIII* (Vol. 7874, pp. 100-108). SPIE.
5. Tripathy, N., & Pal, U. (2006). Handwriting segmentation of unconstrained Oriya text. *Sadhana*, *31*, 755-769.
6. Garg, N. K., Kaur, L., & Jindal, M. K. (2010, April). A new method for line segmentation of handwritten Hindi text. In *2010 seventh international conference on information technology: new generations* (pp. 392-397). IEEE.
7. Lemaitre, A., Camillerapp, J., & Coüasnon, B. (2011, January). A perceptive method for handwritten text segmentation. In *Document recognition and retrieval XVIII* (Vol. 7874, pp. 100-108). SPIE.
8. Mistry, N., Vashi, S., Patel, V., Shah, K., Rixawapla, D., Rakholiya, F., & Savant, R. INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY A REVIEW ON SEGMENTATION TECHNIQUES OF LINES, WORDS AND CHARACTERS ON GUJARATI HANDWRITTEN DOCUMENT USING OCR.
9. Zagoris, K., Amanatiadis, A., & Pratikakis, I. (2021). Word spotting as a service: an unsupervised and segmentation-free framework for handwritten documents. *Journal of Imaging*, *7*(12), 278.

10. Khaissidi, G., Elfakir, Y., Mrabti, M., El Yacoubi, M., & Chenouni, D. (2016). Segmentation-free word spotting for handwritten Arabic documents.

11. Chaudhari, S., & Gulati, R. (2014). Segmentation problems in handwritten Gujarati text. *International Journal of Engineering Research & Technology (IJERT)*.

12. Krishnan, P., & Jawahar, C. V. (2016). Matching handwritten document images. In *Computer Vision–ECCV 2016: 14th European Conference, Amsterdam, The Netherlands, October 11–14, 2016, Proceedings, Part I 14* (pp. 766-782). Springer International Publishing.