JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Devnagari Handwritten Character Recognition Using Deep Convolutional Neural Network

Malvika Jadhav[1], Mayuri Patil[2], and Shruti Buchade[3],
Mrs.R.R.Gaur[4]
UG Student, Nanasaheb Mahadik College of Engineering, Peth
Assistant Professor, Department of Computer Science and Engineering, Nanasaheb Mahadik College of Engineering, Peth

Abstract- — **Segmentation of cursive devnagari handwriting text is the challenging step of Optical Character Recognition (OCR).The recognition accuracy will highly depend on the good segmentation. Segmentation of cursive handwriting is very tough task. The segmentation may be done on the idea of segmentation, a line phase of text, a word phase from line and character phase from word. This can be done by the use of horizontal, vertical methods. By reviewing many basic and advanced techniques of handwritten word segmentation, we try to find the most optimal segmentation bred out of them. The importance of segmentation is to find the accurate new segmented words in order to make a new data set. There are many segmentation algorithms available but each algorithm has different accuracy. The Purpose of this project is to combine different structural and stochastic segmentation algorithms. The proposed system will be segmenting cursive handwritten devnagari text. For this free available dataset from online source. By comparing the accuracy of other segmentation techniques we have tried to implement edge and region segmentation from structural segmentation & ANN from stochastic segmentation as hybrid segmentation.**

Index terms- ***Deep Learning, Image Segmentation, Structural Segmentation, Stochastic Segmentation, ANN.***

I. Introduction

Optical character recognition could be a program that translates a scanned image of a document into a text document which will be embedded. Segmentation of cursive devnagari handwriting is incredibly troublesome. Devnagari Character segmentation is an operation of extracting an individual character from the text or as to decompose a picture into the sub-image of individual symbols. There are primarily 3 phases of a personality recognition system, particularly preprocessing, segmentation and recognition.Preprocessing aims to produce information that is simple for the OCR system to figure accurately. Preprocessing consists of different activities, where it reduces noise and distortion, removes skewness and performs skeleton sing of the image, thereby simplifying the process for the next stages. Subsequent stage is segmenting the document into its sub- components. It separates the various logical components, like text from graphics, line of a paragraph, and character of a word. Preprocessing helps the next stage to enable proper segmentation which would further be used for the recognition.

Segmentation is the process which focuses on dividing an object into different parts according to the object of our interest or as per the features and their properties. Segmentation is the important step in cursive script recognition where it detects lines from the image, then detects words from each line and then extracting individual characters from each word. Segmentation has a wide range of applications such as image based searching, number plate identification, face recognition and many more. So, Segmentation is a very important step for further analysis. The higher recognition rate is achieved when the characters are correctly isolated from the input document or image. In this we need to improve the accuracy and precision of segmentation technique and compare the results with some standard benchmark dataset.

There are different types of segmentation techniques such as Edge Segmentation, Region Segmentation, ANN based segmentation, which are under Structural Segmentation and Stochastic Segmentation algorithm. In Edge based Segmentation, different edge filters are applied on the images where the pixels are classified into edges and non-edges of an image depending on the output of the filter. Region Segmentation is segmentation technique where it recursively finds the neighboring pixel based on the similar seed pixel based on the similarity measures.ANN based segmentation is an Artificial Neural Network based Segmentation algorithm where it uses discrete pixel values of an image for Segmentation .Every single Segmentation algorithm has some drawbacks which result in low accuracy, there is no such algorithm which would work perfectly for all types of images considering all factors such as noise, speed, accuracy, complexity. So the best solution to reduce the drawbacks and increase the accuracy is to make it a hybrid. Hybrid Segmentation combines the different segmentation algorithm from the Structural Segmentation and different Stochastic

Segmentation algorithm.

Using just one Segmentation technique does not give us 100 % of accuracy so our approach is to combine the segmentation technique that is edge segmentation and region segmentation from structural Segmentation and ANN and machine learning classification from stochastic segmentation so as to create hybrid segmentation technique on handwritten cursive dataset which would reduce the drawbacks of the individual segmentation and will result in the better accuracy than the individual segmentation.

II. Related work

There is a lot of work done on handwritten documents whereas a very less amount of work is done on cursive handwritten documents.
Segmentation is the crucial task for classification and recognition of cursive handwritten documents.

Xiao and Leedham used the knowledge of English characters for segmentation. Bretto et al. presented a segmentation algorithm using Hypergraph theory. They have used Hypergraph theory for developing image-processing applications such as segmentation. However, the segmentation they need proscribed is for image pictures and not for cursive written words. Cheng et al. improved the segmentation process to detect ligatures by the analysis of direction features along with neural validation but made the whole process computationally expensive by intruding lot of features. Hence cannot be used in real time scenario.

Most common challenges faced during segmentation of cursive scripts:-
There can be variation in shapes and writing styles of different writers. Cursive nature of handwriting i.e. two or additional characters in an exceedingly word will be written connected to every alternative. Characters can have more than one shape according to their position inside the word image. Words may be written by a pen having ink of different colors.
a.Over Segmentation
b.Bad Segmentation
c.Missed Segmentation

Through the study of previous work related to segmentation it is know that:-
1. Some have used the character shape analysis, ligatures analysis using the one from these four segmentation approaches or a combination of these two;-
i) projection-based, ii) smearing-based, iii) Hough transform-based, and iv) grouping methods
2. Some have used Connected Components Chains along with any other projection or segmentation technique.
3. Implicit segmentation technique achieved segmentation and recognition at the same time. Implicit segmentation based recognition removed the class overlapping problem. The explicit segmentation based approach was computationally complex than the implicit segmentation approach, but the explicit segmentation technique achieved better results than implicit segmentation technique.

4..Some paper have used structural techniques like edge/region or any other segmentation technique along with the neural networks for validation so that whichever points have not been covered by the previous algorithm gets detected and then the proper action can be taken.

In literature, most of the researchers integrated segmentation approaches with some intelligent techniques such as neural networks, support vector machines and so on to enhance accuracy. For the sake of space, a brief comparison of achievement for segmentation rate is presented. Verma and

Gader obtained 76.52% segmentation rate using neuro-feature based approach on words taken from CEDAR; however the number of word was not mentioned. Likewise, Blumenstein and Verma claimed 78.85% segmentation accuracy without mentioning number of words taken from CEDAR. In the same way, Verma claimed 84.87% segmentation accuracy for 300 CEDAR words. Similarly, Cheng et al.acquired 95.27% segmentation rate from 317 CEDAR words. Finally, Cheng and Blumenstein employed three trained neural networks for fine character segmentation. Accordingly, confidence obtained from each network fused to decide final segmentation points. Beside training issues and computational complexity that was raised significantly, trained network could not perform desired objective . Recently, Lee and Verma [21] reported 83.46% segmentation accuracy on 200 wordsof CEDAR.

It was observed that neural networks are mainly used for validation not for actual segmentation purpose.

It is found that there is no perfect method for image segmentation because image segmentation depends on many factors, i.e., pixel color, texture, intensity, similarity of images, image content, and problem domain. Therefore, it is not possible to consider a
single method for all type of images nor all methods can perform well for a particular type of image. Hence, it is good to use hybrid solution consists of multiple methods for image segmentation problem. Table1 we have rated the various segmentation algorithms against the parameters such as speed, Complexity, Noise resistance, Accuracy & Automation.

The below table shows our observations from previous study.

Parameter	Edge based	Region based	ANN based
Speed	1	4	6
Computational Complexicity	1	3	6
Noise Resistance	2	3	1

Accuracy	3	2	1
Automation	5	3	1

Table1:-Comparison table(1 stands for best and 6 forworst)

.

Taking Table1 into consideration that is the advantages and disadvantages of every segmentation technique. So that we can improve overall segmentation accuracy/efficiency.
Table1 shows the comparison that the speed and computation is faster of edge and region based but noise and accuracy is the issue with both the techniques whereas ANN fills this gap i.e the drawback of edge and region based segmentation approach. As the main aim of our is to increase segmentation accuracy for better recognition ANN is helping us with it.
By fusion or by taking different techniques (making hybrid) together can definitely increase our performance of accuracy.

As Edge detection cannot find exact boundaries of the image further ANN can be fed with the segmented images which would help in detecting and correcting over segmentation and also will help is marking exact boundaries of the characters within the image.

III. Proposed Work

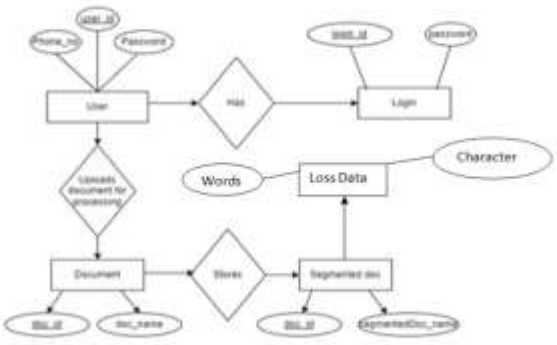


Fig. System Architecture

Fig 1 shows the architecture of proposed system. As Devnagari segmentation plays very important role in classification and recognition, its accuracy contributes to the great extend in classification. Proposed system will be segmenting the cursive text into individual characters with high accuracy with the help of Hybrid Segmentation. Datasets of cursive handwritten text from different writers has been collected from free online database which is freely available.

Steps included in Hybrid Segmentation are:-

1. Preprocessing of data

Noise Removal using Median filter.
Binarization using otsu's algorithm.
Skewness Detection using Hough Transform.

2. Hybrid Segmentation
Edge detection using Canny algorithm.
ANN bases segmentation.

Image Preprocessing

Image Preprocessing plays very important role in segmentation or even in classification and recognition. Clean and noise free image makes it easier to compute any operation on it. Therefore before segmenting the characters from the image it will undergo through preprocessing techniques.

Firstly, we use median filter for reducing impulsive and salt or pepper noise and also used for reducing random noise. After median filter we get clean and noise free image. Secondly, we are going to apply binarization technique using OTSU's algorithm. Otsu method helps in finding optimal threshold value of an input image by going through all possible values(0-255). This helps in converting image pixels into bi-level collection of pixels ie. into black and white pixel. In this way we get an enhanced image Thirdly, For detecting skewness of image Hough Transform method is used. Using Hough Transform feature extraction technique we can detect and correct skewness of images by converting an image from cartesian to polar coordinates.

Hybrid Segmentation

In the proposed technique user will first register into the system here we are going to use MYSQL as the database backend. After registration user will login to system and upload the PDF document but when user will upload PDF document we will internally convert it into the images as one page is equal to one image.After creation of images will complete we will apply the segmentation technique from structural as Edge detection. In the Edge Detection technique we are finding the boundaries within the image. From the Edge detection we are going to use the canny edge detection algorithm. The canny edge detection algorithm has several steps. Noise Reduction, Gradient Calculation, Double threshold. When our edge detection technique is completed we will apply the region based segmentation.In the region based segmentation we are going to grow the regions by including neighboring pixel that are

connected to seed pixel. Region based segmentation is based on two method Region Growing and Region Spilling and Merging Method. In the region growing technique we start with the some pixel as the seed pixel and then check for adjacent pixel. In the region splitting the complete image is treated as single region and then after image is divided into multiple regions. When our Structural Segmentation is done we will apply Ann based segmentation and machine learning classification.

ANN is best and most widely used tool to perform pattern Segmentation and recognition including optical character recognition.

The Process of ANN is as follows

1. ANN is first trained with available cursive characters.
2. Then Segments are fed to ANN to check each segmented character against trained character.
3. If ANN is fails to recognize during feeding of first segment then all combined segments are fed together.
4. This process is going to repeat until
5. ANN recognizes complete character.

Natural language processing (NLP):

Natural language processing (NLP) is the ability of a computer program to understand human language as it is spoken and written -- referred to as natural language. It is a component of artificial intelligence.

How NLP is used for Missing word prediction:

The task of predicting the missing word in a sentence might seem irrelevant if one thinks of natural language processing (NLP) only in terms of processing text for semantic understanding. However, NLP also involves processing noisy data and checking text for errors. For example, noisy data can be produced in speech or handwriting recognition, as the computer may not properly recognize words due to unclear speech or handwriting that differs significantly from the computer's model. Additionally, NLP could be extended to such functions as spell checking in order to catch errors in which no word is misspelled but the user has accidentally typed a word that she or he did not intend. In the sentence "I picked up the phone to answer her fall," for instance, fall may have been the intended word, but it is more likely that the call was simply mistyped. A spell checker cannot catch this error because both fall and call are English words. An NLP algorithm that could catch this error would thus need to look beyond what letters from words and instead attempt to determine what word is most probable in a given sentence.

IV. Results

1. Registration Window

Fig Registration Window

2. login Window

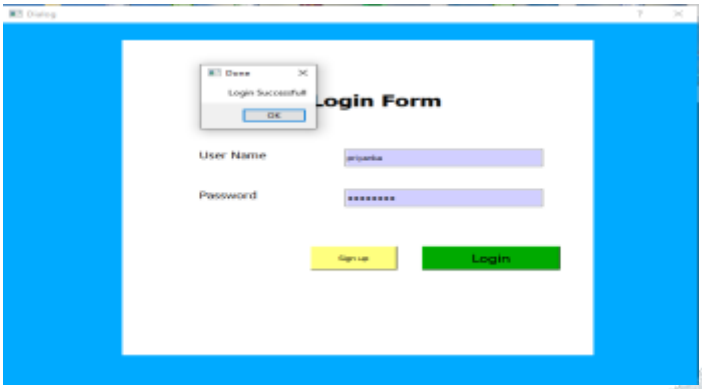


Fig Login Window

3. Main Dashboard

Fig Main Dashboard

4. OTSU Threshold

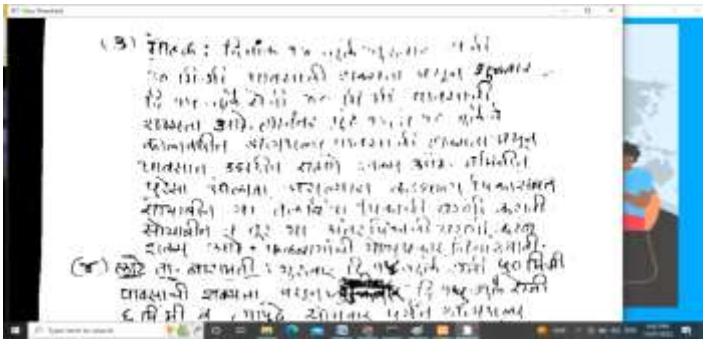


Fig OTSU Threshold

5. Edges

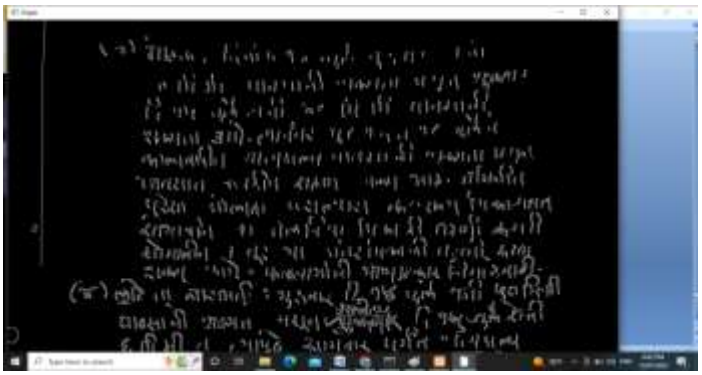


Fig Edges

6. Stoc Segmentation

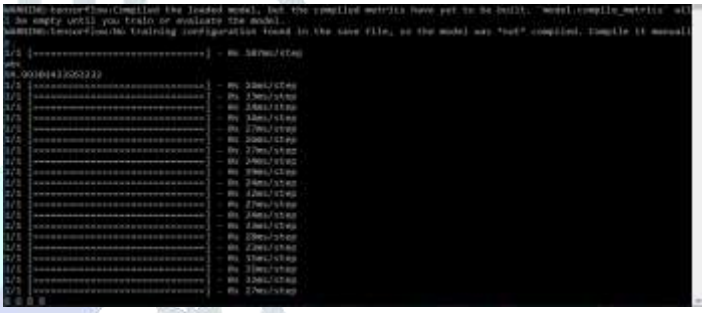
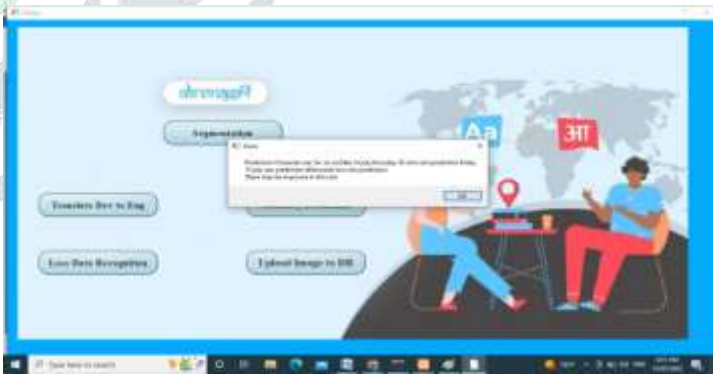


Fig Stoc Segmentation

7. Devnagari to English



8. Prediction Accuracy

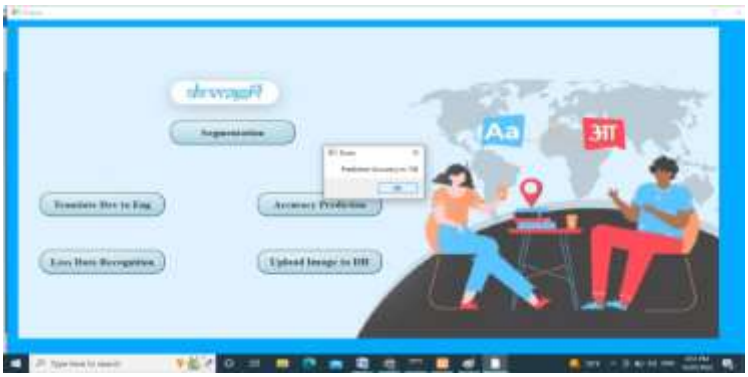


Fig Prediction Accuracy

9. Loss Data Recovery

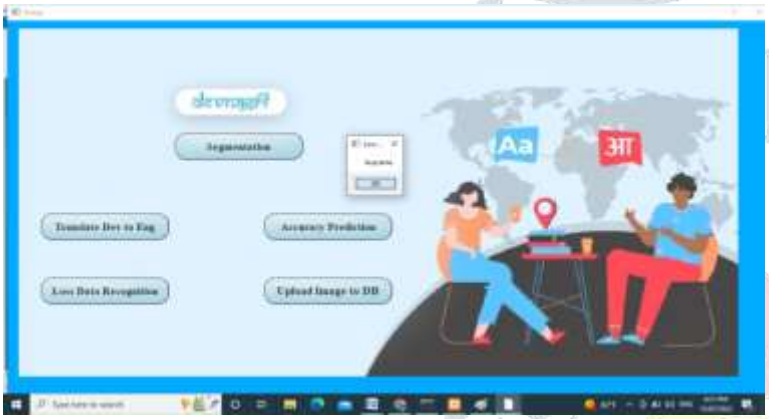


Fig Loss Data Recovery

V. Conclusion

In this paper, 3 segmentation primarily based approaches for cursive handwriting recognition is conferred. By elaborated analysis of the literature, hybrid segmentation using Edge detection segmentation, Region segmentation and ANN based segmentation is implemented. By applying the three segmentation technique we can say that accuracy and
Precision will be achieved for better recognition of cursive handwritten text.

REFERENCE

[1] A. Phukan, M. Borah, "A survey paper on character recognition focusing on offline character recognition," International Journal of Computer Engineering and Applications, vol. 6, pp. 51-60, 2021.

[2] A. Choudhary, "A review of various character segmentation techniques for cursive handwritten words recognition," International journal of Information and Computation Technology, vol. 4, pp. 559-564, 2021.

[3] A. Choudhary, R. Rishi, and S. Ahlawat, "A new approach to detect and extract characters from off-line printed images and text," Information Technology and Quantitative Management, pp. 434-440, 2020.

[4] A. Choudhary, R. Rishi, and S. Ahlawat, "A new character segmentation approach for off-line cursive handwritten words," Information Technology and Quantitative Management, pp. 88-95, 2020.

[5] A. Rehman, D. Mohamad, and G. Sulong "Implicit Vs Explicit based script segmentation and recognition: A performance comparison on benchmark database," International Journal Open Problems Compt. Math., vol. 2, pp. 352-364, 2019.

[6] H. Lee, and B. Verma, "Binary segmentation with neural validation for cursive handwriting recognition," Proceedings of International Joint Conference on Neural Networks, pp. 1730-1735, 200

[7] Alaa Hamid and Ramzi Haraty, "A Neuro Heuristic approach for segmenting handwritten Arabic Text and verification using ANN", Lebanese American University, P.O. Box 13-5053 Chouran Beirut, Lebanon 1102 2801

[8] CATALIN AMZA, "A review on Neural Network-Based Image Segmentation Techniques", De Montfort University, Leicester, LE1 9BH

[9] Varun Wahi1 and Prabukumar Manoharan2 , " Survey and Comparison of various Image Segmentation Techniques", International Journal of Pure and Applied Mathematics Volume 120 No. 6 2018, 11799-11812

[10] Amandeep Kaur, Seema Baghla and Sunil Kumar, "Study of various character segmentation techniques for offline cursive handwritten text", vol-3 Punjab University.