COMPARISON BETWEEN KANNADA AND ENGLISH HANDWRITTEN WORD RECOGNITION BY USING NEURAL NETWORKS

Shakunthala B S¹, Dr. C S Pillai²

¹Research Scholar, VTU-RC, ACS College of Engineering, Department of CSE, Bangalore, India
²Professor, ACS College of Engineering, Department of CSE, Bangalore, India
E-mail: ¹shakukit@gmail.com, ²pillai.cs5@gmail.com

ABSTRACT

Handwritten character recognition is a complex task because of various writing styles of different individuals. Our Method yeilds good classification accuracy on handwritten characters, apart from complexity. Normalization and binarization are the pre-processing techniques used for getting accurate results of classification process in handwritten character recognition.

Keywords: Handwritten Word Recognition, Kannada and English, Neural Networks

I. INTRODUCTION

Kannada is a dravidan language, mainly used by peoples of Karnataka, Andrapradesh, Tamilnadu and Maharastra. Kannada is spoken by 48 millian peoples, The Kannada alphabets were developed from the Kadamba and Chalaukya scripts, descendants of Brahmi which were used between the 5th and 7th century A.D. The basic structure of Kannada script is distinctly different from Roman script. Unlike many North Indian languages, Kannada characters do not have shirorekha (a line that connects all the characters of any word) and hence all the characters in a word are isolated. This creates difficulty in word segmentation. Kannada script is more complicated than English due to the presence of compound characters. However, the concept of upper/lower case characters is absent in this script.

Kannada has 49 base characters, called as Varrnamale as shown in Figure.1.1 comprising 15 vowels, 34 Consonants. consonants modified by all the 15 vowels. Such consonant-vowel combinations are called live consonants (gunithakshara or diacritics) as shown in Figure 1.2.

![Figure 1.1: Kannada Language 49 Phonemic Letters](image1)

![Figure 1.2: Kannada Consonants and Vowels](image2)
1.1 Difficulties in Kannada language

Handwritten Kannada characters/words recognition is a very difficult task due to the unconstrained shapes, variation in writing style (line orientation, line spacing) and different kinds of noise.

Text line components

- Baseline
- Median line
- Upper line
- Lower line
- Overlapping letters
- Touching components
The effect of author style

- Prominent line variation
- Line orientation and line spacing

Effect of poor image quality

English is most popular language, this language has 26 characters as shown in Figure 1.5, among 26 characters it contains 5 vowels and 21 consonants. These distinct characters modify the base consonants is called consonant and vowel modifiers. The number of consonant and vowel modifiers also same as base characters. Consonants, consonant modifiers and vowel modifiers are combine together to form an aksharas, also called as base character.

\[
\begin{array}{cccccccccccccccccccc}
A & B & C & D & E & F & G & H & I & J & K & L & M \\
N & O & P & Q & R & S & T & U & V & W & X & Y & Z
\end{array}
\]

Figure 1.5: English alphabets

II. WORD RECOGNITION

Word recognition contains 3 important steps i) Preprocessing

ii) Segmentation

iii) Classification

2.1 PREPROCESSING

Preprocessing generally consist of series of image to-image transformations. It is preliminary step which transforms the data into a form that is more easily and effectively processed. The main task of preprocessing is to process the scanned image and increase the noise that causes a reduction in the recognition rate and increases the complexities.

Hence preprocessing is an essential stage prior to the segmentation, as it controls the suitability of the results for the success of the recognition. Preprocessing is divided into 4 Steps.

1. Noise removal
2. Conversion to grayscale
3. Conversion to binary
4. Dialation and erosion
2.1.1 Noise removal
The handwritten documents are the input image, these documents are scanned from left to right, right to left and top to bottom, bottom to top using HP scanner. If poor quality of HP scanner, the bubbles, dots and unwanted information appeared in the document, then the quality of the document will be reduced.

2.1.2 Gray scale conversion
Initially input image is in RGB colour (Red, Blue and Green), this RGB coloured image is converted in to white and block image.

2.1.3 Binarization
Grayscale image is converted into binary image is called binarization.

First separating foreground information and background information. Then compare intensity value and existing threshold value. If the intensity value of the image is more than the existing threshold value then the pixel value is changed to 1. If the intensity value of the image is less than the existing threshold value then the pixel value is changed to 0. Black pixel values is denoted as 1’s assigned to the object. White pixels values denoted as 0’s assigned to background. In which region does not contains any text that is eliminated from the binary image then that image is traversing in top, bottom, left and right directions. Finally textual part of the image is obtained.

2.1.4 Dilation and Erosion
Word level segmentation on the binarized document do not get good accuracy due to broken character or word. Single word is segmented in to more than one word or more than two increasing the objects of the binary image.

Erosion : it is used for decreasing the objects of the binary characters, overcome this disadvantages dilation and erosion are used.

Dilation: this is primitive morphological operations, it is used for image. The objects of the binary image is increases / decreases, the shape of the image is changed is called structuring element. Dilation will be used for connecting the disconnected components. Erosion will be used for elimination of pixels/dots in the document.

2.2 SEGMENTATION
Segmentation of handwritten text in to lines, words and characters is one of the important step in handwritten character recognition. HCR helps in the identification of words written by the writers. The most important process in HCR is the segmentation where the text is converted in to lines. There are two types of handwritten text.

- Offline HCR
- Online HCR

Offline HCR means writer utilizes pen/pencil for writing anything on the paper. Online HCR means writer utilizes digital tools like the electronic pen for writing purpose. By applying good segmentation techniques the performance of HCR can be increased. It is the process of extracting objects of interest from an image. It subdivides an image into its constituent regions or objects, which are certainly characters. This is need because the classifier recognizes only the isolated characters. Segmentation phase is also crucial in contributing to the error due to touching characters, which the classifier cannot properly tackle. Even in good quality documents, some adjacent characters touch each other due to inappropriate scanning resolution. Segmentation technique is divided into the following submodules:

1. Line Segmentation
2. Letter Segmentation
3. Boundary Detection

2.2.1 PROBLEMS IN SEGMENTATION
Problem 1 A problem that occurs with the above segmentation is that in handwritten text, there high chances of slant lines which can lead to an incorrect line cropping. Figure 1.6 shows the problem of slant line in an image.

![Figure 1.6: slant line segmentation](image)

Solution The slant line problem can be overcome by sending such images into the line crop function once again after the letter crop. By using this flow, the slant lines in the incorrectly segmented lines are divided vertically by the letter crop making the 3 lines shorter and straight, as a result of which the characters get segmented separately in the second line crop.

Problem 2 Another issue is in case the characters are written too close such that there is no enough empty space between the characters to be detected by the letter crop function. In this case the characters are not segmented correctly which leads to incorrect recognition. Solution The boundary determination is used to overcome this error. Here assumption is made that all slant line problem is overcome and only an image consisting of images in a single line is passed into the boundary detection. Boundary Detection In this stage the connected objects are given a label and a rectangular box is plotted around each connected object. The value of each label is extracted and each rectangular box is cropped to get the isolated character. This isolated character is then sent for feature extraction. Figure 5 shows the problem of close images being solved by the boundary detection.

![Figure 1.7: Boundary Detection](image)

2.3 CLASSIFICATION

Classification contains 2 important steps

i) Classification using NN classifier

ii) Conversion to editable format

2.3.1 Classification Using NN Classifier

The feature vector extracted from the segmented character is assigned a label using a classifier. Recognition of segmented characters is performed using NN Classifier. The recognition performance of Back Propagation network will highly depend on the structure of the network and training algorithm. Feed forward back propagation neural network has been selected to train the network. The number of nodes in input, hidden and output layers will determine the network structure. All the neurons of one layer are fully interconnected with all neurons of its just preceding and just succeeding layers Back Propagation Neural Network Algorithm

1. Initialize the weights to small random values.

2. Randomly choose an input pattern \( \mathbf{x} (\mu) \)

3. Propagate the signal forward through the network.
4. Compute $\delta^l_i$ in the output layer

$$(o_i - y_i^L) \delta^l_i = g^l(h^l_i) [d^l_i - y^l_i]$$

where $h^l_i$ represents the net input to the $i$th unit in $l$th layer and $g^0$ is the derivative of activation function $g$.

5. Compute the deltas for the preceding by propagating the error backwards.

$$\delta^l_i = g^l(h^l_i) \sum_j w^l_{ij} \delta^{l+1}_j$$

for $I = L-1 \ldots 1$

6. Update weights using

$$w^l_{ij} = \eta \delta^l_i y_{j}^{i-1}$$

7. Go to step 2 and repeat for the next pattern until the error in the output layer is below a pre-specified threshold or maximum number of iterations is reached.

2.3.2 Conversion to Editable Format

Based on index value (for template based matching), the Unicode corresponding to the character stored at the obtained index value is stored into a variable letter. The letter value is stored into a word array. The recognized characters are printed on to a notepad which can be further edited and saved.

III. RESULTS

Input data

The input data contain the handwritten word. It can be converting into the gray scale image and then noise is removed in the input handwritten word image as shown below.

![Original image](image1.jpg)

![Gray image](image2.jpg)

![Noise removed](image3.jpg)

![Word extraction](image4.jpg)
IV. CONCLUSION

HCR is the process of identifying the handwritten characters. The text in an image is converted into other letter codes which are usable within computer and text processing applications. Here recognition is done using NN
classifier. It attempts to increase overall efficiency and accuracy of the HCR. Various feature extraction techniques are incorporated to improve the efficiency. Also the image is converted into an editable format. The editable text can be saved and opened for further editing. The current system can be combined with other features to improve the efficiency. An overall architecture for HCR incorporating all these features can be developed to improve the accuracy. Such a structure will help to exploit further domain information in the recognition process. The current system can be extended to recognize votaksharas Kannada handwritten word recognition accuracy is 93.16 and handwritten English word recognition accuracy is 97.13.

REFERENCES