Character Identification of Kannada Text in Scene Images using Neural Network

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Abstract:Text Recognition in natural scene images is becoming a prominent research area and is promoting several new applications such as; car plate recognition, reading aid for the blind, tour guide systems and many more. Text recognition at word/character level is one of the key steps for development of such applications. In this work, a novel method for recognizing Kannada characters in scene images is proposed. The proposed method uses zone wise horizontal and vertical profile based features. The system is efficient and insensitive to variations in size and style, noise, blur and other degradations.

Keywords— **Zone wise features, Scene Images, Pre – Processing, Character Recognition, Neural Network Classifier.**

I. INTRODUCTION

Character recognition is the important area in image processing and pattern recognition, which associates a symbolic meaning with objects (letters, symbols and numbers) drawn on an image, that is character recognition techniques associate a symbolic identity with the image of a character. Mainly, character recognition machine takes the raw data that further implements the process of pre-processing of any recognition system. On the basis of that data acquisition process, character recognition system can be classified into offline and online character recognition. Off-line character recognition refers to the process of recognizing characters that have been scanned from a surface (such as a sheet of paper) and are stored digitally in gray scale format. After being stored, it is conventional to perform further processing to allow superior recognition. In case of online character recognition, the character is captured and stored in digital form via different means. Usually, a special pen is used in conjunction with an electronic surface. As the pen moves across the surface, the two-dimensional coordinates of successive points are represented as a function of time and are stored in order.

Character recognition is one of the most fascinating and challenging areas of pattern recognition with various practical application potentials. It can contribute immensely to the advancement of an automation process and can improve the interface between man and machine in many applications, some practical application potentials of character recognition system are: Reading aid for the blind, automatic text entry into the computer for desktop publication, library cataloguing, ledgering, automatic reading for sorting of postal mail, bank cheques and other documents, document data compression, language processing and many more.

Recognizing character from scene image presents many challenges including unusual fonts, variable lighting condition, noise, blur, variation in color, complex background, variable writing styles etc. In the proposed work a technique for recognition of basic Kannada character written on the display boards of Karnataka Government Offices is carried out. Modern Kannada language has 49 basic characters, called as varnamale. These are divided into vowels and consonants. Consonants take modified shapes when added with vowels. Vowel modifiers can appear to the right, on the top or at the bottom of the base consonant. In addition, combination of two or more characters can generate a new complex shape called a compound character. Kannada script is more complicated than English due to the presence of these compound characters. However, the concept of upper/lower case characters is absent in this script. Recognition of Kannada characters is more difficult than many other Indian scripts due to higher similarity in character shapes, a larger set of characters and higher variability across fonts in the characters belonging to the same class. There were few attempts made in the recent past for the recognition of Kannada characters.

In this work, a novel method for recognizing basic Kannada characters of natural scene images is proposed. The proposed method uses zone wise horizontal and vertical profile based features of character images. The method works in two phases. During training, zone wise horizontal and vertical profile based features are extracted from training samples and neural network is trained. During testing, the test image is processed to obtain features and recognized using neural network classifier. The system is efficient and insensitive to the variation in size and font, noise, blur and other degradations. The method achieves recognition accuracy of 94%.

II. PROPOSED METHODOLOGY

The proposed method uses zone wise horizontal and vertical profile based features for character recognition. The method consists of various phases such as, pre-processing, feature extraction, training neural network and character recognition model. Figure 1 shows the block diagram of the proposed model. The detailed description of each is given in the following subsections.

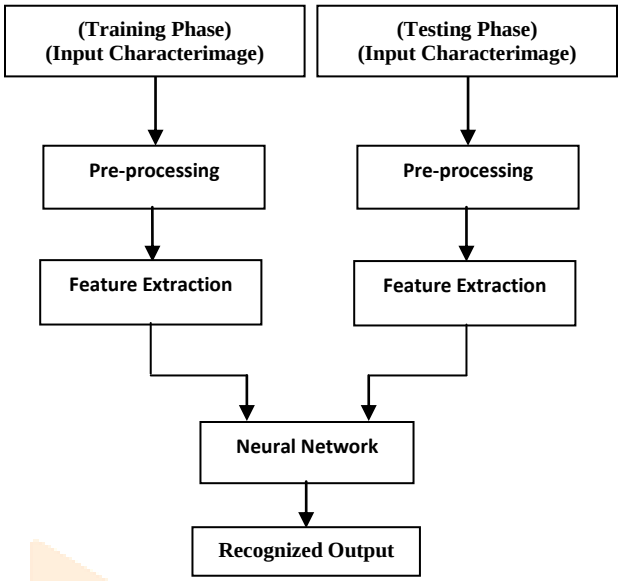

Fig. 1. Block Diagram of Proposed Model.

A. Pre-processing

The scene text images have issues like lighting effects, shadowing, blur, colour degradation and size etc. The purpose of this phase is to make the images to be of standard size and remove complex backgrounds easier for further processing. Pre-processing procedure consists of several steps, which are as detailed below;

Binarization

The input character image is converted into binary image that has only two possible values for each pixel represented by either 0 or 1. Character word image is resized to fixed size based on length.

Thinning

Thinning refers to the process of reducing the width of a line like object from many pixels wide to just single pixel. This process can remove irregularities in letters and in turn, makes the recognition algorithm simpler because they only have to operate on a character stroke, which is only one pixel wide.

Bounding Box Generation

Before analysing any character of the character image, it is important to identify the (pixel) boundaries of that character. Thus, a bounding box is generated around the image.

B. Feature extraction

Features are extracted from the pre-processed image, each image is divided into 15 vertical zones and 15 horizontal zones, where size of each horizontal zone is 2*30 and the size of each vertical zone is 30*2. Then sum of all pixels in every zone is determined. Finally we obtain 30 features that are stored in feature vector. Feature vector is shown in the equation (1).

$$FV = S_i \text{where } 1 <= i <= 30 \quad (1)$$

Where, FV is the Feature Vector,

S_i is the features of the ith zone.

C. Neural Network Training

The Feed Forward Neural Network is used for training the network. The features generated from the training database are used to train the model. Input vectors and the corresponding target vectors are used to train a network until it can approximate a function, associate input vectors with specific output vectors or classify input vectors in an appropriate way according to database. Each input is weighted with an appropriate weight matrix. The sum of the weighted inputs and the bias, form the input to the transfer function. The Neural Network that is used for the training has 30 input neurons as it has 30 input features, 38 hidden neurons and 6 output neurons. Figure 2.2 shows the Neural Network overview.

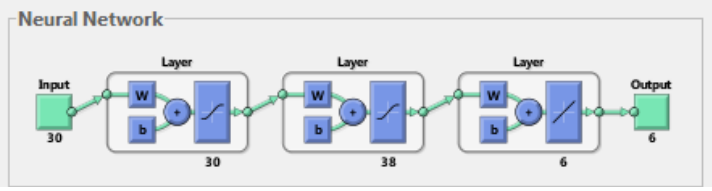

Fig. 2. Neural Network Model.

D. Character Recognition Model.

Test image is processed to obtain zone wise horizontal and vertical profile based features, which are further fed to Neural Network for recognition.

III. Experimental Results and Discussions

The dataset is collected from government office display boards, traffic boards and boards written on various buildings in Karnataka. The dataset consists, 490 images of basic Kannada characters. The proposed methodology for character recognition system has been evaluated for various samples dealing with various issues for different images. The method achieves recognition accuracy of 94%. The system is efficient and insensitive to the variation in size and font, noise, blur and other degradations. The experimental results of testing various character images with varying font styles, size and backgrounds are given below.

E. Sample Kannada Character Image containing Blur

The character image that is selected from the database is given in figure 3. The image has several challenges like unusual fonts and size, blur etc. Pre-processing step is performed to make the images to be of standard size, remove complex backgrounds and makes them easier for further processing in word recognition. In Pre-processing step the colour image is converted into gray scale image, then into binary image. The binary image is resized and then applying thinning process and bounding box. Then features for each word are extracted and then testing is performed.

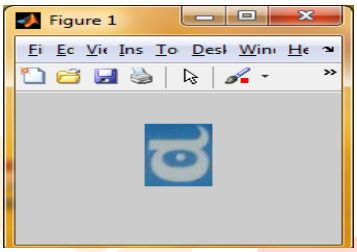

Figure 3Basic Character ttha.

The resulting gray scale image and resized binary image is shown in figure 3.1 and figure 3.2 respectively.

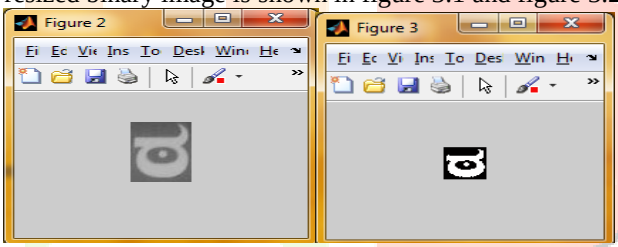

Figure 3.1Gray Scale Image. Figure 3.2 Resized Binary Image.

The resulting thinned image and thinned image with bounding box is shown in figure 3.3 and figure 3.4 respectively.

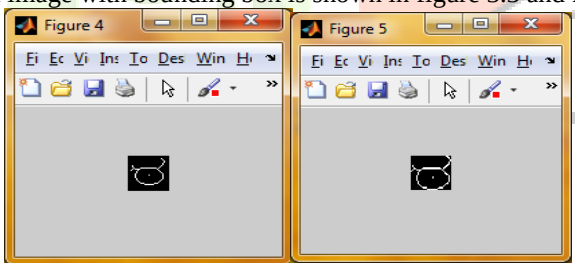

Figure 3.3 Thinned Image.Figure 3.4 Thinned Image with Bounding Box.

The zone wise vertical and horizontal profile features are as follows.

4 3 13 5 6 86 6 8 67 6

9 13 134 2 2 3 6 34 95 5

6 4 4 5 9 15

The method is able recognize character correctly in the presence of blur. The recognized pattern is given in table 1.

Table: 1 Output Pattern for Character Image ttha.

Character Image	Corresponding Output Pattern	Recognized Character image
	**0 1 1 0 1 0**	

F. Sample Kannada Character Image with Dark Background

The character image that is selected from the database is given in figure 4. The image has challenge like dark background. The resulting gray scale image and resized binary image is shown in figure 4.1 and figure 4.2 respectively.

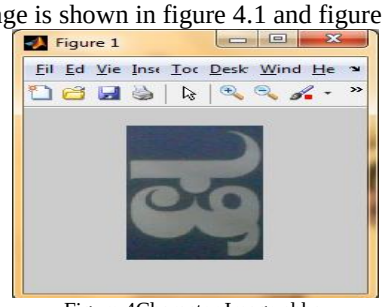

Figure 4Character Image shha

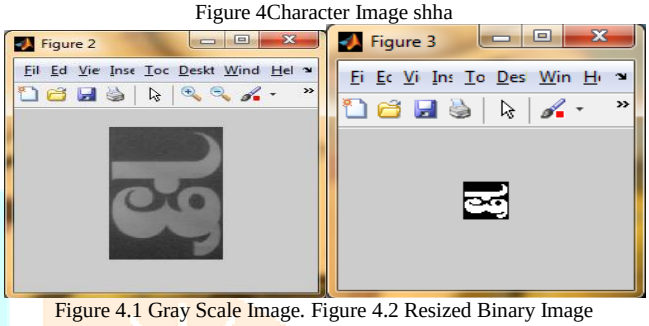

Figure 4.1 Gray Scale Image. Figure 4.2 Resized Binary Image

The thinned image is shown in figure 4.3. Thinned image with bounding box is shown in figure 4.4.

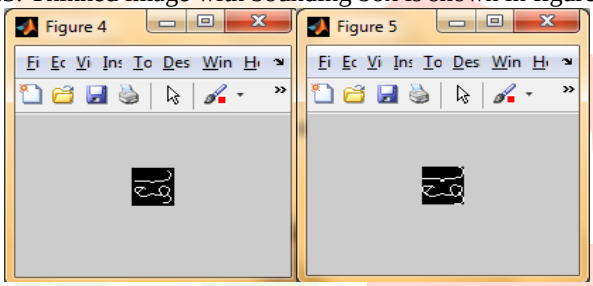

Figure 4.3 Thinned Image.Figure 4.4 Thinned Images with Bounding Box.

The zone wise vertical and horizontal profile features are as follows.

8 9 8 7 5 4 5 6 4 4

11 7 8 14 17 3 2 2 2 25

6 4 14 9 8 13 23 2 2 6

The method is able recognize character correctly in the presence of dark background.The recognized pattern is given in table 5.

Table 2 Output Pattern for Character Image Shha.

Character Image	Corresponding output pattern	Recognized Character image
	1 0 1 1 0 1	

G. Sample Kannada Character Image containing Noise

The Character image that is selected from the database is given in figure 5. The image has challenge like noise. The resulting gray scale image and resized binary image are shown in figure 5.1 and figure 5.2 respectively.

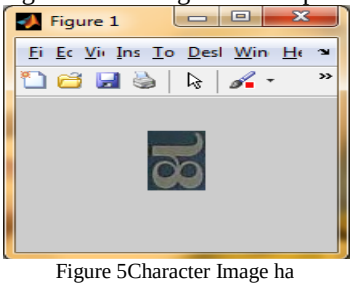

Figure 5Character Image ha

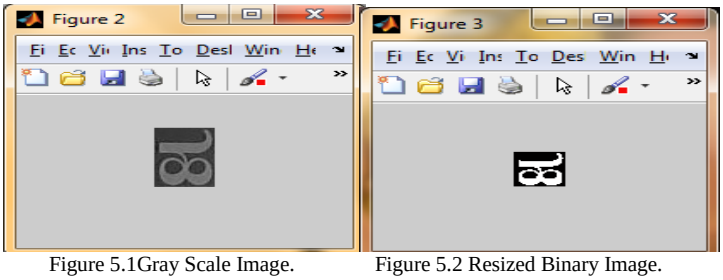

Figure 5.1Gray Scale Image. Figure 5.2 Resized Binary Image.

The thinned image is shown in figure 5.3,Thinned image with bounding box is shown in figure 5.4

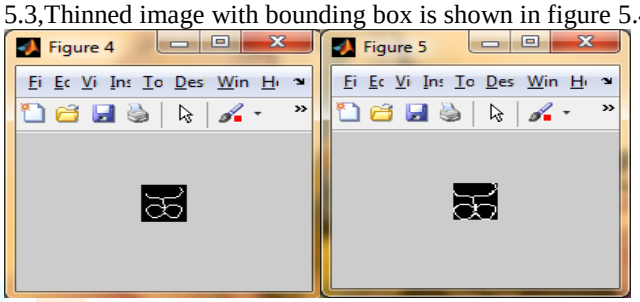

Figure 5.3 Thinned ImagesFigure 5.4 Thinned Images with Bounding Box.

The zone wise vertical and horizontal profile features are as follows.

12 8 6 6 6 6 14 18 8 6

6 6 9 14 10 3 2 2 6 8

22 2 2 17 17 97 12 10 16

The method is able recognize character correctly in the presence of noise.The recognized pattern is given in table 3.

Table 3 Output Pattern for Character Image Ha.

Character Image	Corresponding output pattern	Recognized Character image
	1 0 1 1 1 1	

Though, scene images contain certain challenges, theproposed method works efficiently.

The experiment is performed on 490 images where in 392 character samples are used for training and testing is done on 490 character samples. The following table 4 shows overall performance of the system.

Table 4 System Performance

Trained Samples	Tested Samples	Correctly Recognized Samples	Falsely Recognized Samples	Recognition Accuracy
392	490	461	29	94%

IV. Conclusion

This work strives toward a novel methodology that aids pre-processing and recognition of Kannada Characters from camera based images. The proposed methodology is based on zone wise horizontal and vertical profile based features and neural network as a classifier for Kannada Character Recognition. The system works in two phases training phase and testing phase. Exhaustive experiments are done for analysis of zone wise horizontal and vertical profile based features.

The system successfully processes camera based images having challenges like variable lightning condition, noise, blur, unusual fonts etc. The methodology is tested with 490 samples and gives recognition accuracy of 94%. The method can be extended for word recognition considering new set of features and classification algorithms.

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