Unconstrained Handwritten Kannada Numeral Recognition

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***Abstract*—Handwritten Character Recognition (HCR) is very important in academic and production fields. The recognition system can be either online or offline. There is a large scope for optical character recognition on hand written documents. India is a multilingual and multi script country, where eighteen official scripts are accepted and have over hundred regional languages. Recognition of unconstrained hand written Indian scripts is difficult because of the presence of numerals, vowels, consonants, vowel modifiers and compound characters. In this paper we have implemented to recognize the unconstrained handwritten Kannada numeral characters and have proposed the projection distance metrics method for numeral recognition and General Regression Neural Network (GRNN) for the classification of the character image.**

***Index Terms*—Feature Extraction Method (FEM), Dataset Size (DS) and Classification Method (CM).**

I. Introduction

Off-line handwriting recognition is the subfield of Optical Character Recognition (OCR). Several methods of recognition of Latin, Chinese, Arabic, English scripts are excellently reviewed in [1, 2, 3, 4]. Research in HCR is more popular for various practical application potentials such as reading aid for the blind, bank checks, automatic pin code reading of postal mail to sort etc. The survey for the feature extraction method is found in [5]. Feature extraction methods includes Template matching, Projection histograms, Contour profiles, Zoning, Zernike moments etc. India is a multi-lingual and multi-script country, where eighteen official scripts are accepted and have more than hundred regional languages. The work done on Indian languages is excellently reviewed in [6].

Grid based feature extraction method for Bangla numerals are reported in [7]. An efficient fuzzy method for Bangla handwritten numeral recognition is found in [8]. Fuzzy based recognition and grid based feature extraction for handwritten Hindi numerals are found in [9]. Handwritten numeral recognition for six popular Indian scripts is found in [10]. Few works on recognition of Kannada numerals are also found in [11, 12, 13]. Recognition of hand-

Written Indian scripts are difficult because of the presence of numerals, vowels, consonants, vowel modifiers and compound characters.

The most important factor is the selection of feature extraction method to achieve the high recognition performance. In this work we propose a simple method for feature extraction based on projection based distance metric and zoning for numeral recognition and GRRN method for image classification. We tested our proposed method for Kannada numerals. The proposed method gives around 98% of recognition accuracy for Kannada.

The rest of the paper is consists of four Section. In Section II we will briefly explain about input set and preprocessing. In Section III, we will discuss about the proposed methodology. Section IV describes the results and comparative study and in the final section V, conclusions and future scope of the work will be discussed.

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II. Input Set and Prepocessing

Kannada is a Dravidian and official language spoken about 50 million people in the Indian state of Karnataka. At present no standard Kannada numeral database is available. We have collected 100 samples from different writers where it needs pre-processing steps. The samples of Kannada numerals from the input set as shown in Fig. 1.

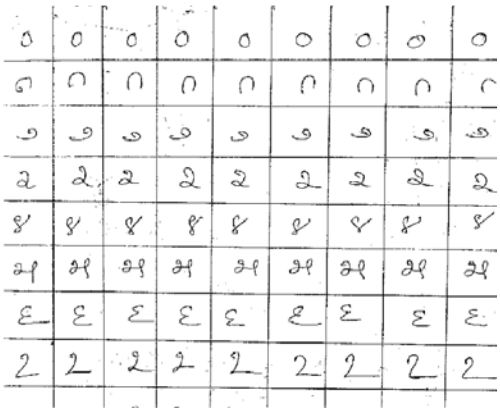

Fig. 1. Samples of kannada numerals

Pre-processing steps are necessary to bring the input data into an acceptable form which is recognized by the computer for feature extraction and classification. Normalization is required as the size of a numeral varies from person to person. Thinning is the process of reducing thickness of each line of pattern to just a single pixel. The Figure-2 shows the steps involved in our proposed method as par pre-processing is considered.

III. Methodology: Feature Extraction and Classification

Our proposed method is projection based distance metric and zoning for feature extraction and GRNN for image classification. The feature extraction method consists of three steps. In the first step, the method processes with size

normalization and followed by thinning algorithm. In the next step, feature extraction based on vertical projection distance metric and zoning is used for efficient character representation. In final step, classification is done based on General Regression Neural Network (GRNN).

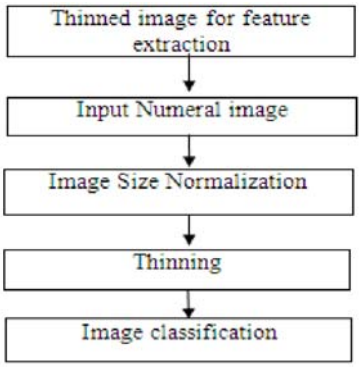

Fig. 2. Pre-processing of numerals

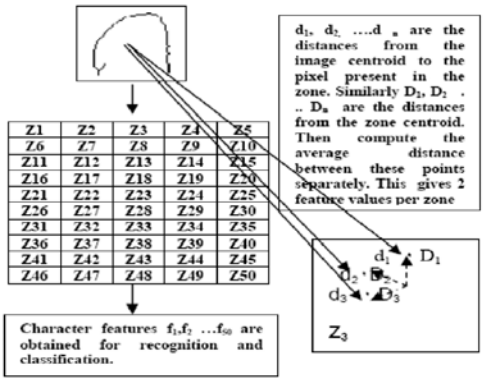

Fig. 3. Graphical representation of projection distance metric and zoning

The input numeral image is normalized to size 50 x 50.Thinning algorithm based on mathematical morphology is operated on the input normalized image. In the next step, the image is divided into twenty five equal parts as shown in the Figure-3. Hence for each box/grid there will be 5 columns and 10 rows. For each grid column, compute the pixel distance (vertical projection distance metric). If there is more than one pixel then compute average pixel distance to get feature vector of that box/grid column. Repeat this for rest of the columns in that grid. Hence we get 10 such features for each grid. There could be some grid columns that are empty pixels, and then the values of such particular grid column image value in the feature vector are zero. The graphical representation about the logic is shown in Figure-3. Repeat this procedure sequentially for all the grids present in the input numeral image. Finally 250 such features are used for feature extraction.

Algorithm: Vertical projection distance metric and box based recognition system.

Input: Handwritten numeral Image

Output: Classification

Method Begins

Step 1: Apply thinning algorithm for numeral image.

Step 2: Divide the image into 25 equal parts

Step 3: Compute pixel distance for grid column.

Step 4: Compute average pixel distance if there is more than one pixel in grid column

Step 5: Repeat the step 3 and 4 for the entire grid columns present in the image.

Step 6: Finally, 250 such features (10 features for each box) will be obtained for classification.

Step 7: Classify the numeral using GRNN.

Method Ends

IV. Results and Comparative Study

In order to evaluate the performance of the proposed method, for recognition and classification purpose GRNN is used. Table I shows the recognition results for Kannada handwritten numerals taking different testing samples and Fig. 4 shows the simple example result of classified image. Table II provides the comparative results with the existing methods and the proposed method.

TABLE I: Recognition Results for Kannada Handwritten Numerals at Different Testing Samples

	% Recognition (For different Testing samples)				
Kannada Numerals	20	40	60	80	100
0	100	100	100	100	100
1	100	100	100	100	100
2	95	95	93	93	93
3	97	97	94	93	93
4	100	99	99	95	95
5	100	100	100	100	100
6	98	95	94	92	90
7	99	99	95	94	92
8	100	98	95	95	92
9	99	95	90	88	85
Average recognition	98.8	97.8	96.00	95.00	94.00

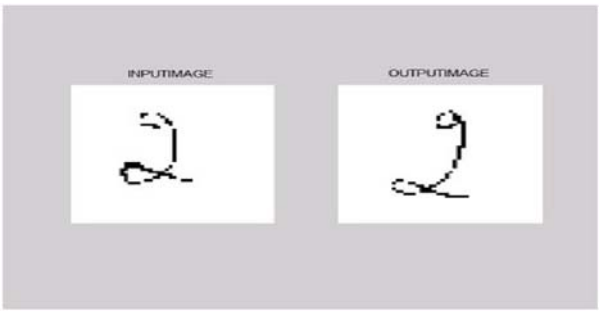

Fig. 4. Simple example result of classified image

TABLE II: Comparative Results With the Existing Methods and the Proposed Method

Methods	FEM	DS	CM	Accuracy
N.Sharma et.al[11]	Chain Code	2300	Quadratic Classifier	97.87%
Dinesh Acharya et.al[12]	Structural Features	500K	Means Classifier	90.5%
Rajaput et.al[13]	Image Fusion	1000	Nearest Neighbor	91.2%
Our Proposed Method	Projection distance metric	1000	Generalized regression Neural Network	98.8%

V. Conclusion

The proposed method is capable of recognizing unconstrained handwritten numerals with highest recognition efficiency of 98.8% for Kannada Numerals. Proposed method provides good recognition without certain preprocessing stages like filtering, slant removing and skewing. Our future work is to improve classifier to achieve still good recognition rate.

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