Advances in Computational Research, ISSN: 0975–3273, Volume 1, Issue 2, 2009, pp-52-55

# Recognition of isolated handwritten Kannada vowels

**Sangame S.K.[1], Ramteke R.J.[1], Rajkumar Benne[2]**
[1]Department of Computer Science, North Maharashtra University, Jalagaon
[2]P.G Department of Studies and Research in Computer Science, Gulbarga University, Gulbarga,
Sunsang2003@gmail.com, rgbenne@yahoo.com

**Abstract**-This paper presents unconstrained handwritten Kannada vowels recognition based upon invariant moments. The proposed system extracts Invariant moments feature from zoned images. A Euclidian distance criterion and K-NN classifier is used to classify the handwritten Kannada vowels. A total 1625 image are considered for experimentation and overall accuracy found to be 85.53%. The novelty of the proposed method is independent of size, slant, orientation, and translation in handwritten characters.
**Keywords**- OCR, Indian Language, Kannada Vowels, Moment invariants

## Introduction

OCR systems are now available commercially at affordable cost and can be used to recognize many printed fonts. Even so, it is important to note that in some situations these commercial software are not always satisfactory and problems still exist with unusual character sets, fonts and with documents of poor quality. Unfortunately, the success of OCR could not extend to handwriting recognition due to large variability in people's handwriting styles. Handwritten Kannada characters are more complex for recognition than English characters due to many possible variations in order, number, direction and shape of the constituent strokes. The number of authors is attempts to make for developments of OCR system for Devanagari, Bangla, Malayalam, Kannada, and Tamil characters with different approaches [2,6,7,8,9]. A method based on invariant moments and the divisions of numeral image for the Recognition of Handwritten Devanagari Numerals has been presented by Ramteke et.al. [3]. Niranjan S.K. et.al[9] proposed a method based on FLD for Unconstrained Handwritten Kannada Character Recognition. Font and size independent OCR system for printed Kannada documents using support vector machines has been published by T.V. Ashwini and Sastry [1]. Ivind due trier, et.al [7] presented various feature extraction technique for handwritten character recognition. From the literature survey, it revels that, handwritten character recognition of foreign languages like English, Chinese, Japanese, and Arabic are reaches to saturation point, but there is room for Indian languages like Kannada script. The Kannada character is complicated to segmentation and reorganization compare to English languages, because of Kannada character complex in nature. This has motivated us to design a recognition system for Kannada character recognition. Rest of the paper is as follows: In Section 2 we discussed about the properties of Kannada language and Kannada vowels preprocessing. Section 3 deals with the feature extraction. Details of the classifier used for the vowels recognition is presented in Section 4. The experimental results are discussed in Section 5. Finally, conclusion is given in Section 6.

## Kannada Language

Kannada is the official language of the southern Indian state of Karnataka. Kannada is a Dravidian language spoken by about 44 million people in the Indian states of Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra.The Kannada alphabets were developed from the Kadamba and Calukya scripts, descendents of Brahmi which were used between the 5th and 7th centuries AD. There are 13 Vowels (Swara), 2 Yogavaha and 34 Consonants (Vangana) in modern Kannada script [9]. In this paper we constrain ourselves to recognition of handwritten Kannada vowels. Printed Kannada vowels and their corresponding handwritten vowel samples are shown in Fig.1 and Fig.2, to get an idea about the shape difference between printed and handwritten samples.

## Vowels pre-processing

The standard database for Kannada handwritten vowels character is not available; therefore, our own database created. Data collected from different professionals belonging to schools, colleges, and commercial sectors. We collected 1625 images from 125 writers are considered for the experimentation purpose. A flat bed scanner was used for digitization. Digitized images are in gray tone with 300 dpi and stored as BMP format. We have used global threshold binarizing algorithm to convert them to two-tone (0 and 1) images (Here '1'represents object point and '0'represents background point). Scanned isolated Vowel images often contain noise that arises due to printer, scanner, print quality, etc. therefore, it is necessary to filter this noise before we process the recognition of Kannada vowels. The noise removed by using median filter and scanning artefacts are removed by using morphological opening operation

ಅ ಆ ಇ ಈ ಉ ಊ ಋ

ಎ ಏ ಐ ಒ ಓ ಔ

Fig. 1- Sample of printed Kannada Vowels

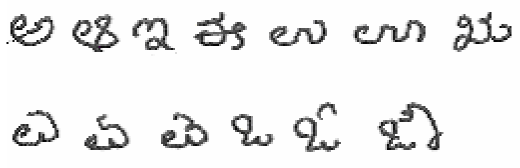

Fig. 2- Sample of handwritten Kannada Vowels

**Feature extraction**

Features extraction is the identification of appropriate measures to characterize the component images distinctly. There are many popular methods to extract features. Considering the centric image as the feature as at one end of the spectrum. The representation is bulky and contains redundant information. At the other extreme, there are feature extraction schemes which consider some selected moments or other shape measurements as the features. Area, projection parameters moments, fringe measures, number of zero crossing etc., are popular for recognition of Indian scripts. Selection of a feature extraction method is probably the single most important factor in achieving high recognition performance. In any character recognition system, the characters are processed to extract features that uniquely represent properties of the character. The invariant moments are found to be invariant with respect to translation, rotation, scaling and reflection [4,5,6]. So, the extracted features should be independent of these operations. The set of sever invariant moments (Φ1 – Φ7), was first proposed by Hu for 2 – D images. The invariant moments are evaluated using central moments of the image function f(x, y) up to third order.

The central moments up to third order are evaluated with the expression

$$\mu_{pq} = \sum x \sum y (x-\bar{x})^p (y-\bar{y})^q f(x,y)$$
(1)

Where for p, q = 0, 1, 2,….., and $\bar{x}.and.\bar{y}$ are moments evaluated from the geometrical moments $m_{pq}$ as follows,

$$\overline{X} = m_{10}/m_{00} \quad \text{and} \quad \overline{Y} = m_{10}/m_{00}$$
(2)

$$m_{pq} = \sum_x \sum_y x^p y^q f(x,y)$$
(3)

The central moments of order up to 3 are as follows in expression (4)

$$\mu_{00} = m_{00}$$
(4)

$$\mu_{10} = 0$$

$$\mu_{01} = 0$$

$$\mu_{11} = m_{11} - \overline{Y} m_{10}$$
$$\mu_{20} = m_{11} - \overline{X} m_{10}$$
$$\mu_{02} = m_{02} - \overline{Y} m_{01}$$
$$\mu_{30} = m_{30} - 3\overline{X} m_{20} + 2\overline{X}^2 m_{10}$$
$$\mu_{03} = m_{03} - 3\overline{Y} m_{02} + 2\overline{Y}^2 m_{01}$$
$$\mu_{21} = m_{21} - 2\overline{X} m_{11} - \overline{Y} m_{20} + 2\overline{X}^2 m_{01}$$
$$\mu_{12} = m_{12} - 2\overline{Y} m_{11} - \overline{X} m_{02} + 2\overline{Y}^2 m_{10}$$

The normalized central moment to shape and size of order (p+q) is defined as

$$\eta_{pq} = \mu_{pq} / \mu_{00}^{\lambda}$$
(5)

for p, q = 0, 1, 2, ……where

$$\gamma = \frac{(p+q)}{2+1} \tag{6}$$

For (p + q) = 2, 3, ……

As set of seven moment invariants can be derived from these equations given in equations

$$\phi_1 = \eta_{20} + \eta_{02} \tag{7}$$
$$\phi_2 = (\eta_{20} - \eta_{02})^2 + 4\eta_{11}^2$$
$$\phi_3 = (\eta_{30} - 3\eta_{12})^2 + (3\eta_{21} - \eta_{03})^2$$
$$\phi_4 = (\eta_{30} + \eta_{12})^2 + (\eta_{21} + \eta_{03})^2$$
$$\phi_5 = (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] + (3\eta_{21} - \eta_{03})(\eta_{21} + \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2]$$
$$\phi_6 = (\eta_{20} - \eta_{02})[(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{21} + \eta_{03})$$
$$\phi_7 = (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] + (3\eta_{12} - \eta_{30})(\eta_{21} + \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2]$$

It has been shown that moments are invariant to translation, rotation, Scale change and reflection. The expressions given by Equations (7) are used to evaluate 7 central invariant moments i.e., (Φ1 – Φ7) which are used as features. To increase the success rate, the new features need to be extracted based on division of the images.

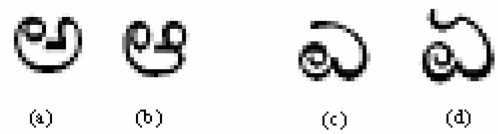


Fig.3- Four Kannada Vowels images. Images (a) & (b) and (c ) & (d) are similar in nature.

As the concept of invariant moment discussed above i.e., invariant to reflection, there is a problem in recognition of some character as shown in fig. 3., because of their similarity under reflection. The recognition rate is found very poor using the seven invariants. Therefore, the image is divided into 4 zones (Upper – left, Lower – left, Upper – right and Lower – right) on the basis of center of character computed using following equation.

$$X = \sum_{j=1}^{n} W_{iJ} * j / N \qquad (8)$$

$$Y = \sum_{j=1}^{n} W_{ij} * i / N \qquad (9)$$

Where (i, j) represents (i, j)th pixel, Wij = 1, if pixel is black, otherwise it is zero. N is the number of 1's in the character. After getting the center, we evaluated the invariant moments features of each parts. Thus, 28 features are extracted form four zones of an image. All these features are used in the recognition system. Vowel image divided into four zones as shown in Fig.4.

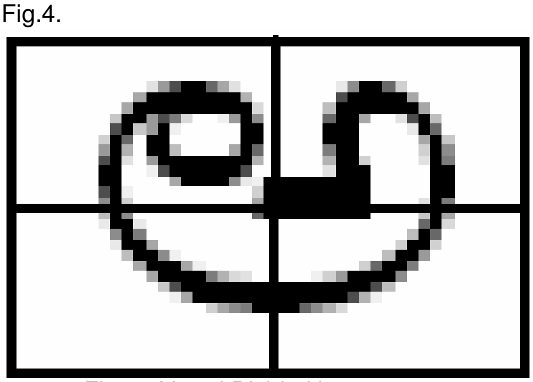

Fig. 4- Vowel Divided into 4 zones

**Classification**

K-Nearest-Neighbor (KNN) classifier: Nearest neighbor classifier is an effective technique for classification problems in which the pattern classes exhibit a reasonably limited degree of variability. The k-NN classifier is based on the assumption that the classification of an instance is most similar to the classification of other instances that are nearby in the vector space. It works by calculating the distances between one input patterns with the training patterns. A k-Nearest-Neighbor classifier takes into account only the k nearest prototypes to the input pattern. Usually, the decision is determined by the majority of class values of the k neighbors. In the k-Nearest neighbor classification, we compute the distance between features of the test sample and the feature of every training sample. The class of majority among the k-nearest training samples is based on the Eclidian minimum distance

**Experimental results and discussion**

Proposed algorithm uses 1625 handwritten Kannada vowels for experimentation purpose. We considered 1300 samples for training purpose and 325 samples for testing purposes. K-NN classifier used to classify the test sample with different value of K.=1,3,5. as shown in the table 2. However K=1 performs better. The overall accuracy found to be 85.53% as shown in the table 1. K-NN classifier .

*Table 1-Test Results for Kannada vowels*

| Train samples 1300, Test samples 325 | | | |
|---|---|---|---|
| Vowels | Test sample | Correct Classificatio | Rate of recognition |
| ಅ | 100 | 84 | 84.00 |
| ಆ | 100 | 84 | 84.00 |
| ಇ | 100 | 92 | 92.00 |
| ಈ | 100 | 88 | 88.00 |
| ಉ | 100 | 92 | 92.00 |
| ಊ | 100 | 88 | 88.00 |
| ಋ | 100 | 88 | 88.00 |
| ಎ | 100 | 80 | 80.00 |
| ಏ | 100 | 80 | 80.00 |
| ಐ | 100 | 88 | 88.00 |
| ಒ | 100 | 84 | 84.00 |
| ಓ | 100 | 80 | 80.00 |
| ಔ | 100 | 84 | 84.00 |
| **Average Recognition** | | | **85.53** |

*Table 2- Recognition results for different k values with K-NN classifier*

| Different k values for NN | % of recognition |
|---|---|
| K=1 | 85.53 |
| K=3 | 83.69 |
| K=5 | 81.53 |

 

## Conclusion

In this paper, we attempt to recognize the handwritten Kannada vowels. We extracted 28 Moment invariants features from each character image and considered for recognition system. The novelty of this method is independent of size, slant, orientation, and, translation. This work is carried out as an initial attempt towards handwritten Kannada characters recognition system.

## References

[1] Aswin T. V. and Sastry P. S. (2002) Sadhana 27(1), 35 – 58.

[2] Veen Bansal, Sinha R.M.K. (2001) Proc. Symposium on Translation support system (STRANS-2001), Kanpur, India

[3] Ramteke R. J., Borkar P. D., Mehrotra S. C. (2005) International Conference on Cognition and Recognition (ICCR 2005), Mysore, (Karnataka), India.

[4] Ramteke R. J., Mehrotra S. C. (2006) IEEE International Conference on Cybernetics and Intelligent System (CIS-2006), Bangkok, Thailandh.

[5] Gonzalez R.C., Woods R.E. (2002) Digital Image Processing, Pearson Education.

[6] Alexander G. Mamistvolov (1998) IEEE Trans. PAMI, 20 (8), 819-831.

[7] Nagabhushan P., Angadi S.A., Anami B.S. (2003) Proc. Of 2nd National Conf. on Document Analysis and Recognition (NCDAR-2003), Mandy, Karnataka, 275-285.

[8] Ivind due trier, Anil Jain, Torfiinn Taxt (1996) Pattern Recg, 29 (4), 641-662.

[9] Sharma N., Pal U. and Kimura F. (2006) International Conference on Information Technology, ICIT-06, 2006.

[10] Niranjan S.K., Vijaykumar, Hemanth Kumar G., Manjunath Aradhya V. N. (2008) Conference on Future Generation Communication and Networking Symposia, IEEE proceedings, 7-10.