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Recognition of Off-Line Handwritten Rajasthani Characters using Generalized Feed Forward Classifier

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Abstract: ***The offline handwritten identification in the area of pattern recognition was a heavy and difficult task. Because of its application in different areas, a set of work is being done and the results are continuing to be strengthened by different methods. We suggested in this paper a handwritten model for individual character recognition using generalized neural networks for feed forward. We take 17 character samples handwritten in scanned image format for experimental purposes; Rajasthani knows 850 different samples of handwritten characters. HOG extraction methods are used to construct pattern vectors for all training sets. These features are recognition classifier for generalized feed forward. We obtained an overall classification with GFF classifier accuracy rate of 85.21% from the proposed scheme for the identification of Rajasthani characters.***

Keywords: Handwritten character recognition, feature extraction, GFF, classifier

I. INTRODUCTION

Handwritten recognition has already been a prominent field for several years due to its future applications. Some of the potential areas of application are postal automation, processing of bank checks, automated data entry, etc. There are many working sections to handwritten recognition in Japanese, Chinese, Roman, and Arabic scripts and different approaches to handwriting recognition have been suggested by the researchers [1]. These days, computers have penetrated more accurately in all areas and work at higher speeds. Pattern recognition computer is a difficult task and if the curves of reasons in written texts in hand, this task becomes even more important. The text conversion process handwritten in machine-readable format is the handwritten character recognition. Some of the most popular relevant fields of research and stimulating in the field of pattern recognition were handwritten character recognition.

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It makes an enormous contribution to the advancement of an automation process and in various applications can improve the human-machine interface. Most of the literature on Indian scripts recognition of transactions with printed materials and very few articles discuss scripting problem handwritten.

Using a special pen and a digital surface, the data are collected in recognition of virtual handwriting through the writing process. Offline files are digitized pre-written text images, generally on a piece of paper [2].

Handwritten recognition systems are generally classified into two types, namely the recognition online and off line manuscript. In the online approach, the two-dimensional coordinates of consecutive points are symbolized with time. Also the sequence of moves made by the writer is at hand. While in the case of handwriting recognition approach offline written script is captured with the help of devices like scanner and the entire script is available as an image [3].

The approaches to handwriting recognition online and offline are compared; it was found that due to time information available with the online approach, it is higher than the offline approach. In addition, in offline systems, neural networks were used to produce good results at relatively high levels of accuracy in recognition. An amount of applications, for example, document analysis, interpretation of the mailing address, treatment, etc. bank require a handwriting recognition system offline. Thus, recognition of handwritten offline recognition has the first preference of many researchers to analyze and discover new methods to achieve better accuracy in recognition. It is used extensively in the area of pattern recognition, artificial intelligence and image processing [4]. In this paper we recommend the framework based on GFFNN classifier for the handwritten character recognition. This is used for training the neural network. The Rajasthani character consists of 38 letters. When to recognize out of these 18 characters, we need to divide them into classes. Through the experiments, the character recognition and classification is carried out and the recognition accuracy is described in the experimental result in section. There are 38 basic characters in Rajasthani script which are shown in figure 1.1.

Fig.1.1: Rajasthani Characters

The handwritten recognition of Rajasthani characters has following applications:

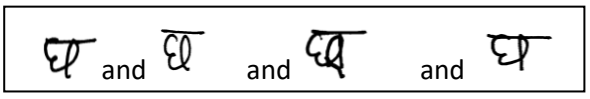
1. In the field of automated letter sorting in postal services
2. In automatic processing of different handwritten forms in different departments and institutes of government
3. In old manuscripts digitization
4. In banks for automated customer signatures validation

In case of Rajasthani characters there are some problems which lead to reduction in recognition accuracy. These problems have been discussed below.

1. There is always variation in the shapes of characters and variation in writing styles of different writers as shown in figure 1.2.

Fig. 1.2: Few Samples of Rajasthani Characters

2. Difference is being shown below among various characters that lead to incorrect recognition:



3. During scanning, it may be possible to manipulate images, to add noise during image acquisition, etc.

The organization of this paper is as follows: previous work was discussed in Section 2, proposed recognition systems were given in Section 3, and experimental results and conclusions were written in Section 4.

II. RELATED WORK

A P Jane et al. recommend a novel mechanism for recognizing handwritten marathi characters of similar shape that use Artificial Neural Network and recording 70 to 90 percent average accuracy [5]. A new Eigen space model method was proposed by Akhil Deshmukh et. al. using the theory of Gerschgorin theorems to identify and extract characters [6]. Mahesh Jangid et. al. suggested new algorithm of correlation characteristics of local Gradients extraction Neighbors for handwriting recognition. They obtained 95.38 percent accuracy for handwritten Devanagari character recognition in order to use this function method and SVM classifier [7]. J. Praddep et.al. developed a model on handwritten character recognition that used a neural network extraction method focused on diagonal feed forward network and back propagation algorithm with two hidden layers in the 54-100-100-38 framework that can be used to distinguish both horizontal, diagonal and vertical orientation characteristics and found 92.69% [8]. P. E. Ajmire et.al., Handwritten character has significant variation in the type of a group of characters. This variability focuses on the font type, the document noise, the photometric effects, the document's oblique and poor image quality. Large variations in shape makes it difficult to determine the number of convenient features before building models. Character recognition system performance depends heavily on what features are being used [9]. P.E.Ajmire et.al. presented the work on the recognition of manuscripts Marathi vowels. The system was tested on 12 Handwritten Marathi vowels and 10 images for each vowel. The overall average recognition rate of vowels before the combination is 59% and after the consolidation of 62%. Therefore the combination improves the recognition rate [10]. Arjun Singh et.al. proposed an offline recognition system Handwritten Devanagari characters. It uses classifiers ANN and SVM. An experiment is performed on the image sizes: 30x30, 40x40 and 50x50 Matlab. The recognition accuracy is 97.61% using SVM [11]. Dineshkumar R. et.al. proposed a recognition framework handwriting offline using the network of neurons before feeding. A Sanskrit manuscript character is recognized by the use of training the neural network. The system proposed recognizing the names written by hand, reading documents and converting any document handwritten shaped structural text. The accuracy rate obtained is 98% [12].

III. DATABASE PREPARATION

We have developed our own database. The preparation of database, which are collected from the special design sheet. The A4 size data sheet is designed for the handwritten character recognition system and the characters were written by the various Rajasthani people of different age groups. After data collection from various person data sheets are scanned with the help of Cannon Lide 110 with 300 dpi and stored as jpg file.

IV. PROPOSED METHODOLOGY

The proposed method designed 17 characters database out of 38 characters. The database contains in all 850 samples datasets.

a) Block Diagram: The following figure shows the complete handwritten character recognition system.

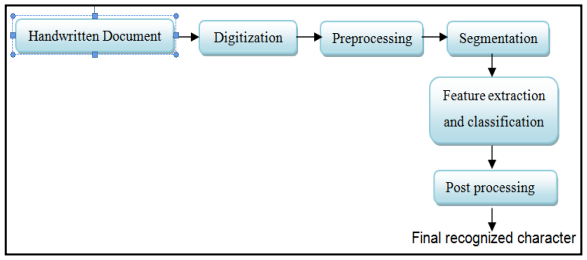


Fig. 1.3 : Complete handwritten character recognition system

b) Algorithm: The following algorithm has been performed in order to preprocess the image before feature extraction:

1. Read Datasheet file (Scan file)
2. Intensity value of an image were adjusted
3. Images were converted and save into gray scale image
4. All gray images were converted to binary
5. Take compliment of this data file
6. Crop each Line and then each character
7. Finally all images resize to 40 x 40 pixels size

In this way the individual characters are available in the form of image in database. Some sample characters in the database are as shown in the figure 1.4.

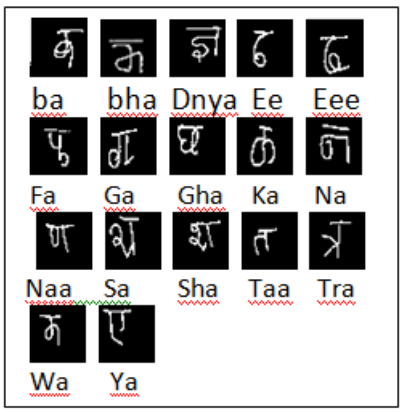


Fig. 1.4: Labeled Database of Rajasthani Character

V. RESULTS AND DISCUSSION

The gradient-oriented characteristics of the histogram for research work were taken. For classification, the extracted characteristics are selected. HOG features define the image form with the distribution of intensity or gradient to the edges. A HOG feature vectors that represent a relative object's local shape. In all 81features are extracted for each character image. In this way the total database contains 850 X 81data values. This paper focuses on Generalized Feed Forward Neural Network (GFFNN) for recognition of handwritten characters. The extracted features vector of all database images is first randomized and then fed to the GFFNN for training of neural network. To identify them, the GFFNN was used to check the proposed vector of various character images. These features are classified using GFF classifier and results for training is given in Table 1, 2 and 3 as well as the result of testing in Table 4, 5 and 6.

Table 1

For Training	
Classifier : GFF	
Characters	% of Accuracy
Eee	100
Ee	100
Ka	100
bha	100
Tra	100
Ga	100

Table 2

For Training	
Classifier : GFF	
Characters	% of Accuracy
ba	93.75
Fa	96.77
Gha	90.32
Sa	96.77
Sha	96.67
Taa	93.33
Na	95.83

Table 3

For Training	
Classifier : GFF	
Characters	% of Accuracy
Naa	58.62
Wa	84.38
dnya	87.50
Ya	86.67

From the result observed above, it is found that the handwritten recognition using GFF classifier on training data, Table 1 shows a recognition accuracy of six characters out of 17 characters is 100% whereas Table 2 shows an accuracy rate of seven characters above 90% and the remaining four characters with an accuracy rate of below 88%.

Table 4

For Testing	
Classifier : GFF	
Characters	% of Accuracy
Eee	100
bha	100
Ga	100

Table 5

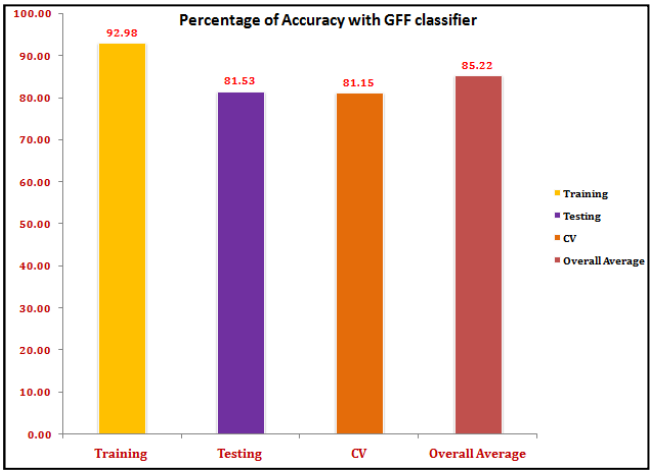
For Testing	
Classifier : GFF	
Characters	% of Accuracy
ba	92.31
Fa	93.33
Tra	90

Table 6

For Testing	
Classifier : GFF	
Characters	% of Accuracy
Naa	46.67
Ee	81.82
Wa	73.33
Ka	83.33
Gha	76.92
dnya	72.22
Sa	72.73
Sha	80
Taa	85.71
Ya	64.29
Na	73.33

On Testing, three characters with a recognition rate is 100% and three characters with an accuracy of recognition above 90% and the remaining eleven characters with an accuracy of less than 80%..

The graphical representation of average accuracy on sets training, testing and cross validation is 92.97, 81.52, and 81.15 respectively as shown below.



VI. CONCLUSION

This paper proposes an algorithm of recognition of handwritten Rajasthani characters. The average accuracy of recognition of all handwritten Rajasthani characters in training, testing and CV using GFF is 85.21%. This accuracy may be enhanced by taking into consideration a broader set of data while training a classifier. This work can also be applied to other scripts in India for character recognition with offline handwritten language.

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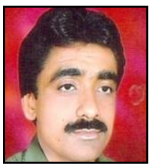

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