Recognition of Off-line Modi Script : A Structure Similarity Approach

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ABSTRACT - The subject of character & handwriting recognition has a great potential in data and has received considerable attention in recent years. Several methods for recognition of Latin, Chinese, and Arabic etc. scripts have been proposed. Among Indian script, some pioneering work has been done on Bengali, Devnagiri, Oriya, Telugu, Urdu scripts and OCR systems for this script are ready for commercialization. Modi script is a cursive typescript of Devnagiri characters. Two major differences between the alphabets and cursive characters can be stated. Cursive script recognition has the context information in a one dimensional way, but graphical alphabets usually are bi-dimensional.In this paper, some structural similarities of standard characters and handwritten characters in Modi script are verified using measured structure similarity approach. The performance rate is found to be 91 to 97 percent which is more promising than other methods.

KEYWORDS – Classification, OCR, Script, Segmentation, Structure Similarity.

I. INTRODUCTION

The analysis of handwritten documents was a subject of intensive research for the last decades. The interest devoted to this field is not only explained from the scientific point of view, but also in terms of the social benefits that convey those systems. Two examples of interesting applications are the analysis of old handwritten archive manuscripts and sketching or calligraphic interfaces. The analysis of ancient documents is a growing interest in Europe and its main concern is not only the digitization but the extraction of knowledge from ancient documents to convert them to digital libraries, so that these documents can be edited and published, contributing to the diffusion and reservation of artistic and cultural heritage. Concerning to sketching interfaces, it is a joint interest among the fields of Pattern Recognition and Human Computer Interaction, which allows computers to integrate a natural way of interaction based on handwritten strokes which are interpreted as textual annotations or graphical gestures. Several methods for recognition of Latin, Chinese, and Arabic script have been proposed. Among Indian script, some pioneering work has been done on Bengali, Devnagiri, Oriya, Telugu, and Urdu scripts and OCR systems for this script are ready for commercialization. To the best of my knowledge, no work has been done on MODI script.

II. METHODOLOGY

A.Classification Methods

Two major focus of interest can be stated: the definition of expressive and compact shape description signatures, and the formulation of robust classification methods according to such descriptors. Zhang [1] reviews the main techniques used in this field, mainly classified in contour-based descriptors (i.e. Polygonal approximations, chain code, shape signature, and curvature scale space) and region-based descriptors (i.e. Zernike moments, ART, and Legendre moments). A good shape descriptor should guarantee inter-class compactness and intra-class separation, even when describing noisy and distorted shapes. It has been proved that some descriptors, robust with some fine transformations and occlusions in printed symbols, are not efficient enough for handwritten symbols. Thus, the research of other descriptors for elastic and non-uniform distortions is required, coping with variations in writing style and

blurring.Concerning classification, numerous techniques (not necessarily independent from each other) have been investigated based on statistical or structural approaches. Elastic deformations of shapes modeled by probabilities tend to be learnt using statistical classifiers. One of the most well-known techniques in this domain is the Adaboost algorithm due to its ability for feature selection, detection, and classification problems [2]. Most classification algorithms are designed for multi-class problems. Nevertheless, this extension is normally hardly difficult. In such cases, the usual way to proceed is to reduce the complexity of the problem into a set of simpler binary classifiers and combine them.

B. Pre-processing

In Pre-processing the raw data, depending on the data acquisition type is subjected to a number of preliminary processing steps to make it usable in the descriptive stages of character analysis. Preprocessing aims to produce data that are easy for the recognition systems to operate accurately [3].

C. Segmentation

The document segmented into its sub components. Segmentation is an important stage, because the extent one can reach in separation of words, lines or characters directly affect the recognition rate of the script [3].

D. Neural Network

Printed Devanagari character recognition is attempted based on the Kohenen Neural Network (KNN) and Neural Network [4].Back-propagation neural network with one hidden layer was used to create an adaptive character recognition system. The system was trained and evaluated with printed text, as well as several different forms of handwriting provided by both male and female participants [5].In the experiment carried out by A Rajput *et al.* [6] Using neural network to recognize printed characters and handwritten characters to test the effect of a set size on recognition accuracy. The technique distinguishes characters by the number of loops in a character and the direction of their concavities. Technique of back propagation neural network found best to solve the character recognition problem with 100% accuracy. As depicted in fig. 1, Modi script is a cursive typescript of Devnagiri characters. By using back-propagation

Fig. 1. Devnagari characters and its corresponding characters in the Modi script

neural network the effect of handwritten modi script characters in character recognition tested. Letters from the sentence in the handwritten modi script were used to create the test set to determine accuracy. A firing rule determines how one calculates whether a neuron should fire for any input pattern. It relates to all the input patterns not only the ones on which the node was trained [7]. A simple firing rule can be implemented by using a Hamming distance technique [8].

E. Neuro-Fuzzy Logic

Jue-Wen Lin et al. Proposed a stroke-based Neuro-fuzzy system for off-line recognition of handwritten Chinese character. The system consists of three main components: stroke extraction, feature extraction, and recognition. Stroke extraction applies a run-length-based method to extract strokes from the image of a given character. Various fuzzy features of the extracted strokes, including slope, length, location, and cross relation, are obtained by the feature extraction module. An ART-based neural network, using a two-stage training algorithm, is used to recognize characters. This system extracts strokes in only two passes, and is free from the presence of spurious and thick strokes. The neural model used provides a faster convergence rate [9].Baemuu Chang et al., 2008 proposed a novel character recognition method called Handwritten Character Recognition using a Neuro-Fuzzy (HCRNF) system. The HCRNF system integrates a Recurrent Neural Network (RNN) and a Fuzzy Inference System (FIS) to recognize handwritten characters. It employs an RNN to effectively extract oriented features of a handwritten character, and then, these features are applied to create an FIS which can powerfully estimate the similarity ratings between a recognized character and sampling characters in the character database [10].

Sreela Sasi et al. Proposed a novel method for automatic handwritten character recognition by combining wavelet packet transform with Neuro-Fuzzy approach. The time-frequency localization and compression capability of the wavelet packet transform using a best - basis algorithm is used for feature extraction, enhancing the accuracy of recognition at pixel level. The best-basis algorithm automatically adapts the transform to best match the characteristics of the signal, minimizing the additive cost function. Since fuzzy sets and fuzzy logic remain as a means for representing, manipulating and utilizing uncertain information and to provide a framework for handling uncertainties and imprecision associated with real world problems, a fuzzy logic system is used for classification purpose. A neural network system is used for recognition purposes since they provide computational power, fault tolerance, and learning capability to the systems. Characteristic features are extracted by taking wavelet packet transform using best-basis algorithm and are given as input to the fuzzy classifier where they are fuzzified and classified using IF... THEN rules, and given to a neural network recognition system. This method is more efficient for handwritten character recognition as well as personal identification compared to energy sorted wavelet transform of character images, since characters contain very few edges in the images. Simulation of characters is done for 3 multi resolution levels using symmlet [11]. Suresh and S. Arumugam in the article introduces different methods for automatic pattern recognition that are motivated by the way in which pattern classes are characterized and defined. The handwritten characters (numerals) are preprocessed and segmented into primitives. These primitives are measured and labeled using fuzzy logic. The strings of a character are formed from these labeled primitives. To recognize the handwritten characters, conventional string matching is performed. However, the problem in this string matching has been avoided using the membership value of the string. This result is being compared with the Modified Parser generated from the Error-free Fuzzy Context-Free Grammar[12]. N. M. Noor, M. Razaz, P. Manley-Cooke, 2004 in the article on Global Geometry Extraction for Fuzzy Logic Based Handwritten Character Recognition provides a possible solution to the problem of character rotation in the offline recognition of isolated handwritten English alphabets. The proposal involves extracting rotationally invariant global geometric properties of a character's image to analyze its shape. The geometric properties extracted are added to the input vectors of two existing classifiers. Experimental results tested on a variety of writing styles have shown that the inclusion of global geometric property extraction[13].

F. Structure Similarity Approach

Perceptual image quality metrics explicitly accounted for human visual system (HVS) sensitivity to sub-band noise by estimating thresholds above which distortion is just-noticeable. A recently proposed class of quality metrics, known as structural similarity (SSIM), models perception implicitly by taking into account the fact that the HVS is adapted for extracting structural information (relative spatial covariance) from images [14] and specific SSIM implemented both in the image space and the wavelet domain.The motivation behind the structural similarity approach for measuring image quality is that the HVS has evolved to do visual pattern recognition in order to be able to extract the structure or connectedness of natural images. Based on this observation, it makes sense that a useful perceptual quality metric would emphasize the structure of scenes over the lighting effects. The idea that image quality metrics can be created on the basis of this philosophy was modified, implemented, evaluated, and developed by Z. Wang, and *et al.* [15].In the experiment we had taken a standard sample image of the modi script with which the handwritten modi script characters are compared. SSIM function generates the accuracy results as shown in the following table 1.

III. RESULTS AND DISCUSSION

Sample1	Handwritten Modi Character Sample2	Structure Similarity
Standard Sample	S1	95
Standard Sample	S2	92.5
Standard Sample	S3	91
Standard Sample	S4	97

Table 1Handwritten modi script recognition accuracy

Using the MATLAB image processing tool, the matrices of each letter of the alphabets of the modi

script are created along with the network structure. Pull the binary input code from the matrix and interpret the binary output code. To test the effect of modi script characters on character recognition, handwriting modi script character samples were scanned and it had been converted to the vectors. Each character image is converted to a Matlab vector. Letters of the sentence written in modi script were used to create the test set to determine the structural similarity between a standard sample of the alphabets of modi script and corresponding handwritten characters.

IV. CONCLUSION

In this paper, different classification, pre-processing, and segmentation methods andpattern recognition techniques like Kohenen Neural Network, and back propagation neural network have discussed. An attempt is made to apply measured structure similarity approach to off-line recognition of handwritten modi characters. The performance rate of SSIM was found to be 91 to 97 percent which is more promising than other methods.

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