An Insight on Handwriting Recognition

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Abstract : Humans have many things in common. But there are various other things that are very unique to every individual, like DNA, fingerprints, etc. Handwriting is one of those things that is unique to every individual. This has been proved in the recent studies on Handwriting analysis. Although it has been said that handwriting can be mimicked and forgery is also becoming a huge issue but still there is certain level of individuality and uniqueness (like the way of holding the pen, the strokes used in the writing and the amount of pressure put on paper, to name a few) that cannot be mimicked or forged. Also, computerization becoming more prominent these days, handwriting recognition is gaining importance in various fields eg. authentication of signatures in banks, recognizing ZIP codes addresses on letters, forensic evidence, etc. Furthermore, if a large scale computational analysis and the authentication work is done in the bank then the burden on other agencies is reduced. But how is it possible for a computer to recognize the handwriting of an individual? Owing to the fact that each individual has his/her own way of presenting his/her ideas on paper, there is much complexity involved in this subject. An overview of some methodologies and recognition algorithms is presented here.

***IndexTerms* – pre processing, feature extraction, classification, neural network.**

I. INTRODUCTION

Handwriting recognition has been one of the most exciting and challenging research areas in field of image processing and pattern recognition in the recent years. It contributes immensely to the advancement of automation processes and has the potential to improve the interface between man and machine in numerous applications and ways. Several research works have been focusing on new technologies and ways that would reduce the processing time and also provide higher recognition accuracy.

All the modern world, computer and communication tools such as word processors, fax machines and e-mail are having their impact on handwriting. These tools have led to the micro-tuning and changing the role of handwriting and handwritten messages. Softwares that process handwritings need to deal with many writing styles and languages, work with different user-defined alpha-bets, and understand any handwritten message by any person. Several types of analysis, recognition and interpretation can be done with handwriting. Handwriting recognition is primarily the task of modifying a language re-presented in its own spatial form of graphical marks into a representation of symbols. Handwriting interpretation is the task of determining the meaning of a piece of handwriting, e.g., an address. Handwriting identification is the process of determining the writer of a sample of handwriting from a set of authors. Verification and Identification are tasks that determine the special nature of the writing of a specific writer, while handwriting recognition and interpretation are tasks whose objectives are to filter out the variations in order to determine the message.

Broadly, handwriting recognition is classified into two types as off-line and on-line handwriting recognition methods:

Off-line recognition: the writing is generally captured optically by a scanner and is generally available as an image. In these systems, the neural networks can be effectively used to yield high recognition accuracy levels. Several applications like mail sorting, bank processing, document reading and postal address recognition require the off-line handwriting recognition systems. This makes the off-line handwriting recognition an active area for research for exploring the newer techniques that would improve recognition accuracy.

On-line recognition: in this type of recognition, the two dimensional coordinates of successive points are represented as a function of time. Also, the order of strokes made by the writer are available. The on-line methods are considered to be superior to their off-line counterparts in recognizing handwritten characters mainly due to the temporal information available with the former.

II. LITERATURE SURVEY

U. Pal et al, have proposed a modified quadratic classifier based scheme to recognize the offline handwritten numerals of six popular Indian scripts.

Multilayer perceptron has been used for recognizing Handwritten English characters. The features are extracted from Boundary tracing and their Fourier Descriptors. Character is identified by analysing its shape and comparing its features that distinguish each character. Also an analysis has been carried out to determine the number of hidden layer nodes to achieve high performance of back propagation network. A recognition accuracy of 94% has been reported for handwritten English characters with less training time.

Dinesh et al have used horizontal/vertical strokes, and end points as the potential features for recognition and reported a recognition accuracy of 90.50% for handwritten Kannada numerals. However, this method uses the thinning process which results in the loss of features.

U. Pal et al have proposed zoning and directional chain code features and considered a feature vector of length 100 for handwritten numeral recognition and have reported a high level of recognition accuracy. However, the feature extraction process is complex and time consuming.

III. PROCESS OF HANDWRITING RECOGNITION

Broadly, a fixed set of processes are followed for handwriting recognition. The first important step in any handwritten recognition system is pre-processing, then segmentation and then feature extraction.

3.1 Preprocessing

It includes the steps that are required to prepare the image into a form suitable for segmentation. In the segmentation process, the input image is divided into individual characters and then, every character is resized into m x n pixels for the purpose of training.

Some of the common operations performed in preprocessing before recognition are:

- Thresholding: for converting a gray-scale image into a binary black-white image
- Noise removal: to extract the foreground or textual matter by removing textured background, salt and pepper noise and interfering strokes
- Line segmentation: the separation of individual lines of text
- Word segmentation: the isolation of textual words, and character segmentation, the isolation of individual character, those that are written discretely rather than cursively

3.1.1 Thresholding

The task of thresholding is to extract the foreground (ink) from the background (paper). The histogram of gray-scale values of a document image typically consists of two peaks: a high peak corresponding to the white background and a smaller peak corresponding to the fore- ground. So, the task of determining the threshold gray-scale value is one of determining an “optimal” value in the valley between the two peaks. The distributions of the foreground and background points are regarded as two classes. Each value of the threshold is tried and one that maximizes the criterion is chosen. There are several improvements to this basic idea, such as handling textured backgrounds similar to those encountered on bank checks.

3.1.2 Noise Removal

Removal of noise is a topic in document analysis that has been dealt with extensively for typed or machine-printed documents. In case of handwritten documents, the connectivity of strokes has to be preserved and maintained. Noise can be introduced during digital capture of images from scanning devices and transmission media. In order to eliminate the articrafts introduced during image capture, smoothing operations are often used. One of the studies, describes a method that performs selective and adaptive stroke “filling” with a neighborhood operator which emphasizes stroke connectivity, while at the same time, conservatively check aggressive “over-filling.”

3.1.3 Line Segmentation

Segmentation of handwritten text into lines, words, and characters has many sophisticated approaches. This is in contrast to the task of segmenting lines of text into words and characters, which is straight-forward for machine-printed documents. It can be accomplished by examining the horizontal histogram profile at a small range of skew angles. The task is more difficult in the handwritten domain. Here, lines of text might be undulate up and down and ascenders and descenders frequently intersect characters of neigh-boring lines. One method is based on the notion that people write on an imaginary line which forms the core upon which each word of the line resides. The local minima points approximate this imaginary baseline from each component. A clustering technique is used to group the minima of all the components to identify the different handwritten lines.

3.1.4 Word Segmentation

Line separation is usually followed by a procedure that separates the line into words. Few approaches in the literature have dealt with word segmentation issues. Among the ones that have dealt with segmentation issues, most focus on identifying physical gaps using only the components. These methods assume that gaps between words are larger than the gaps between characters. However, in hand-writing, exceptions are commonplace be-cause of flourishes in writing styles with leading and trailing ligatures. Another method incorporates cues that humans use and does not rely solely on the one-dimensional distance between components. The author’s writing styles, in terms of spacing, is captured by charactering the variation of spacing between adjacent characters as a function of the corresponding characters themselves. The notion of expecting greater space between characters with leading and trailing ligatures is enclosed into the segmentation scheme.

3.2 Feature extraction

The Selection of appropriate feature extraction method is probably the single most important factor in achieving high recognition performance. Several methods of feature extraction for character recognition have been reported in the literature. The

widely used feature extraction methods are Template matching, Deformable templates, Unitary Image transforms, Graph description, Projection Histograms, Contour profiles, Zoning, Geometric moment invariants, Zernike Moments, Spline curve approximation, Fourier descriptors, Gradient feature and Gabor features.

3.3 Classification and recognition

An artificial neural Network as the backend is used for performing classification and recognition tasks. In the off-line recognition system, the neural networks have emerged as the fast and reliable tools for classification towards achieving high recognition accuracy. Classification techniques have been applied to handwritten character recognition since the 1990s. These methods include statistical methods based on Bayes decision rule, Artificial Neural Networks (ANNs), Kernel Methods including Support Vector Machines (SVM) and multiple classifier combination.

IV. CONCLUSION

A comprehensive study of pre-processing, feature selection, and classification for handwriting recognition has been done. Research on automated written language recognition dates back several decades. Today, cleanly machine-printed text documents with simple layouts can be recognized reliably by off-the-shelf OCR software. in the on-line case, the recently introduced PDAs have practical value. Similarly, some on-line signature verification systems have been marketed over the last few years and instructional tools to help children learn to write are beginning to emerge. In an e-world dominated by the WWW, the design of human computer interfaces based on handwriting is part of a tremendous research effort together with speech recognition, language processing and translation to facilitate communication of people with computer networks. From this perspective, any successes or failure in these fields will have a great impact on the evolution of languages.

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