

A Neural Network Approach to Character Recognition

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Abstract: *In this paper, an attempt is made to develop off-line recognition strategies for the isolated Handwritten English character (A to Z) and (0 to 9). Challenges in handwritten character recognition wholly lie in the variation and distortion of handwritten characters, since different people may use different style of handwritten, and direction to draw the same shape of the characters of their known script. The paper provides a review on the process of character recognition using neural network. Character recognition methods are listed under two main headlines. The Offline methods use the static images properties. The Offline methods are further divided into four methods, which are clustering, Feature Extraction, Pattern Matching and Artificial Neural Network. The Online methods are subdivided into k-NN classifier and direction based algorithm. Character preprocessing is used binarization, thresholding and segmentation method. Neural network based method improves the character recognition. The proposed method is based on the feed forward back propagation method to classify the characters. The ANN is trained using the Back Propagation algorithm. In the proposed system, English numerical letter is represented by binary numbers that are assumed as input and fed to an ANN. Neural network followed by Back Propagation Algorithm which compromises Training.*

Keywords: neural network, ANN, OCR, character recognition, segmentation

1. Introduction

Even today in Twenty first century handwritten communication has its own stand and almost of the times, in daily life it is globally using as means of communication and recording the information like to be shared with others. With the increasing growth of internet, also the demand of online information system has increased. There are various applications like in post offices, banks etc. where character recognition systems are used. The Recognition of characters is known to be one of the earliest applications of Artificial Neural Networks which partially emulate human thinking in the domain of artificial intelligence. Character recognition is the process to classify the input character according to the predefined character class. With the increasing interest of computer applications, modern society needs that the computer should read the text. The text may be in the form of scanned handwritten document or typed text in various fonts or a combination of both. The character recognition system helps in making the communication between a human and a computer easy.

Classical methods in recognition are not perfect for the recognition of visual characters due to the following reasons [4]:

- The same characters differ in sizes, shapes and styles from person to person and even from time to time with the same person. The source of confusion is the high level of abstraction. There are thousands styles of type in common use and a character recognition program must recognize most of these.
- Like any image, visual characters are subject to spoilage due to noise. Noise consists of random changes to a pattern, particularly near the edges. A character with much noise may be interpreted as a completely different character by a computer program.
- There are no hard-and-fast rules that define the appearance of a visual character. Hence rules need to be heuristically

deduced from the samples. Character recognition system is useful in license plate recognition system, smart card processing system, automatic data entry, bank cheque/DD processing, money counting machine, postal automation, address and zip code recognition, writer identification etc. There exist several different techniques for recognizing characters. One distinguishes characters by the number of loops in a character and the other by direction of their concavities. These methods can be used one after the other to increase accuracy and speed for recognition. The main driving force behind neural network research is the desire to create a machine that works similar to the manner our own brain works.

Neural networks have been used in a variety of different areas to solve a wide range of problems. Unlike human brains that can identify and memorize the characters like letters or digits; computers treat them as binary graphics. Therefore, algorithms are necessary to identify and recognize each character. A neural network is a processing device, either an algorithm or an actual hardware, whose design was inspired by the design and functioning of animal brains and components thereof. The neural networks have the ability to learn from example, which makes them very flexible and powerful. These networks are also well suited for real-time systems because of their fast response and computational times, which are because of their parallel architecture. Any pattern recognition system typically consists of a section which defines and extracts useful features from a pattern. Based on that features system is able to recognize the given input pattern. Depending on problems given, the number and variety of features differ according to the extracting methods and ways of representation. In many practical applications, it is not unusual to encounter problems involving hundreds of features. One can think that every feature is meaningful for at least some of discriminations. However, it has been observed in practice that, beyond a certain point, the inclusion of additional features leads to worse rather than better

performance and increase the processing time [5]. Thus the selection of features, i.e. keeping suitable features and omitting unnecessary or probably redundant ones, is a crucial step in a pattern recognition system design.

Character recognition can be divided into two major categories: typewritten and handwritten. In Typewritten recognition recognizes a document that has been previously typed and scanned prior to recognition progress. Such a system would be used as a way to digitize books, documents and papers in libraries, government, or held by companies. In handwritten recognition, the system attempts to recognize a text that has been written by a human. Advantages of character recognition are: reading postal address off envelopes, reading customer filled forms, archiving and retrieving text, digitizing libraries etc. Using OCR, the handwritten and machine written text could be stored into computers to generate databases of existing texts without using the keyboard.

The various methods for character recognition have already been published but the method ,combination of artificial neural networks and genetic algorithm, this becomes the primary advantage of the method over other existing methods. It is advanced than those methods.

2. Literature Review

Lot of work has been done in this field with the help of artificial neural network. ANN involves training of all characters. When unknown input given to the system ANN is able to find out the most probable character by generalization [6]. Numerous techniques for character recognition have been investigated based on four general approaches of pattern recognition, as suggested by Raghuraj [7] template matching, statistical techniques, structural techniques, and neural networks. Hidden Markov Model is a complete statistical model that tries to predict the unknown sequence. So it also tries to recognize the unknown character which is given as input [8]. If the difference between unknown input and training data is large, the system may not behave well. Also the HMM model does not capture the correlations between letters [2]. Alexander J. Faaborg proposed a technique to create an adaptive character recognition system using neural network. Back-Propagation neural Network with one hidden layer is used to create the system. System is trained and evaluated with printed and handwritten English alphabets. He showed in his experimental results that printed text gives better accuracy in recognition than handwritten characters [3]. The back propagation algorithm changes the schematic of the perception by using a sigmoidal function. The advantage of the sigmoidal function is that the sigmoidal function is differentiable [10]. It works well on simple training problems. However, as the problem complexity increases, the performance of back propagation falls off rapidly because of the fact that complex spaces have nearly global minima which are sparse among the local minima. Gradient search techniques tend to get trapped at local minima [11]. Also BPN suffers from the scaling problem.

Neural networks with Back Propagation learning showed results by searching for various kinds of functions. However, the choice of the basic parameter often already determines the success of the training process. The selection of these parameter follow in practical use rules of thumb, but their value is at most arguable. Since first attempts to combine GA and NN started in the late 1980s, other researchers have joined the movement and created a flood of journal articles, technical reports etc. A broad variety of problems have been investigated by different GANN approaches, such as face recognition [Hancock, 1991], animats [Maniezzo, 1994], classification of the normality of the thyroid gland [Schiffmann, 1993], color recipe prediction [Bishop, 1993] and many more. Also, a variety of different encoding strategies have been implemented. Various techniques developed for character recognition.

3. Techniques

Some approaches take a holistic approach, recognizing entire words, while others focus more on recognizing individual characters. Holistic approaches incur more computational cost since there are more models, but have more expressive and discriminative power since the visual cues are gathered over large areas. Fig. 1 shows the classification of character recognition techniques. Basically the character recognition can be done using online and offline methods.

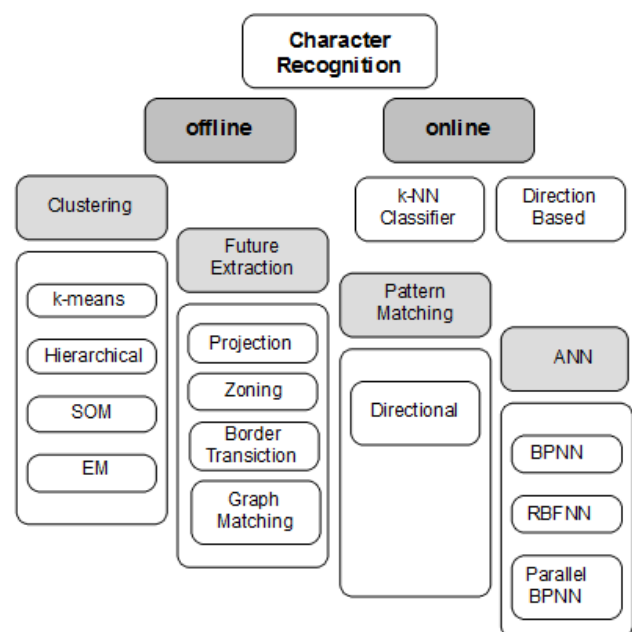


Figure 1: Types of Character Recognition Techniques

3.1 On-line Recognition

On-line handwriting recognition has gained interest due to increase in usage of hand held devices. Nonparametric methods have recognition time proportionate to the training set size. These methods use all points per stroke for calculating the similarity measurement. The challenges posed by the online character recognition system are to increase the recognition accuracy and to reduce the recognition time.

3.2 Off-line Recognition

Off-line recognition operates on pictures generated by an optical scanner. The data is two-dimensional and space-ordered which means that overlapping characters cannot be separated easily. Off-line handwriting recognition involves the automatic conversion of text in an image into letter codes which are usable within computer and text-processing applications. The data obtained by this form is regarded as a static representation of handwriting. Off-line handwriting recognition is comparatively difficult, as different people have different handwriting styles. And, as of today, OCR engines are primarily focused on machine printed text and ICR for hand printed text. Cursive handwriting utilizes the Hough transform and a neural network [6]. The Hough transform is a line detection technique which has the ability of tolerating deformation, disconnections and noise. Instead of searching for linear strokes in the image. These systems work for the recognition of segmented cursive characters, cursive words and the first letter of cursive words.

4. Proposed System

The character recognition system consists of five stages:

1. Data Collection
2. Preprocessing
3. Segmentation
4. Feature Extraction
5. Classification

A typical OCR system consists of above stages given in Fig.2 and sometimes includes few extra stages. The recognition process starts with data collection stage. Data is collected in the form of images of different machine printed alphabets.

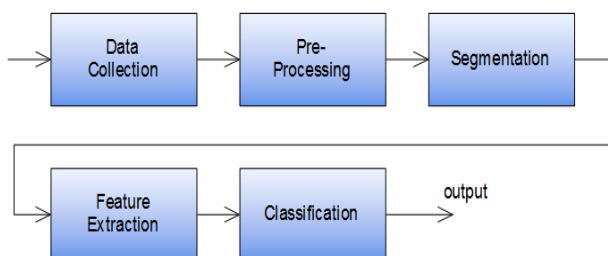


Figure 2: A general diagram for character recognition system

Next in the preprocessing stage the data is converted into binary form. The images are noise free so no need to do extra preprocessing for removing noise. Segmentation is the most important part of OCR systems. This step involves localization of the limits of each character and to isolate them properly. In this the identification of the boundaries of the character and separating them for further processing. After segmentation a set of features are required for each character. In feature extraction stage each character is represented as a feature vector, which becomes its identity. This vector is used to distinguish the character from other characters. The features extracted from the images will be the inputs given Back Propagation algorithm for classification. Character Preprocessing is used binarization, thresholding and segmentation method. The proposed method is based on the use of feed forward back propagation method to classify the

characters. The ANN is trained using the Back Propagation algorithm. In the proposed system, English numerical letter is represented by binary numbers that are used as input then they are fed to an ANN. Neural network followed by the Back Propagation Algorithm which compromises Training.

5. Future Implementation

We present approaches for recognizing hand written characters. The proposed method has been applied on different unknown characters. Neural Network helps the system to recognize the character even if the exact pattern is not available in the database. Neural network based method gives the accuracy 85 %. Developed for proposed algorithms cannot be applied to recognize a cursive handwriting Recognition. In future, we can be tested similar experiment over some other characters and with some more or new parameters to improve the accuracy.

6. Conclusion

This paper introduce on consideration of challenges related to the various character recognition technique. The character recognition methods have developed remarkably in the last decade. A variety of techniques have emerged, influenced by developments in related fields such as image recognition and face recognition. It is hoped that this comprehensive discussion will provide insight into the concepts involved, and perhaps provoke further advances in the area. The difficulty of performing accurate recognition is determined by the nature of the text to be read and by its quality. Features of each character are required based on which a character can be classified. We believe that wise use of features and neural networks has led to improved accuracies. We can combine two or more techniques so as to improve the accuracy of the system. The paper gives a useful method for the recognition of handwritten characters to a great extent.

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