Chapter 2
Machine Learning Techniques in Handwriting Recognition: Problems and Solutions

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ABSTRACT
Handwriting recognition is a process of recognizing handwritten text on a paper in the case of offline handwriting recognition and on a tablet in the case of online handwriting recognition and converting it into an editable text. In this chapter, the authors focus on offline handwriting recognition, which means that recognition system accepts a scanned handwritten page as an input and outputs an editable recognized text. Handwriting recognition has been an active research area for more than four decades, but some of the major problems still remained unsolved. Many techniques, including the machine learning techniques, have been used to improve the accuracy. This chapter focuses on describing the problems of handwriting recognition and presents the solutions using machine learning techniques for solving major problems in handwriting recognition. The chapter also reviews and presents the state of the art techniques with results and future research for improving handwriting recognition.

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INTRODUCTION

Personal Digital Assistants (PDA), Electronic Pen (E-Pen), Electronic-Mail (Email), mobile phones, computers, and so forth are the examples of the representatives in modern communication methodologies. In the last few decades, communication sectors have been changed dramatically from classical manual methods to electronic automations in the ways of delivering or storing the information. The automatic conversion of recognizing handwritten texts is not exceptional. For the last few decades, attempts to digitize machine-printed, known as Optical Character Conversion (OCR), have been very successful. In fact, OCR applications are commercially available off the shelves nowadays, and the performance and accuracy in conversion are very close to perfection. Along with the success in OCR, the research efforts have been made to convert human-printed, ‘handwritten’ texts to digital format. Handwriting is a methodology to aid and expand finite biological human memory by making artificial graphical marks on a surface, which represent symbols in each language. The purpose of handwriting is to communicate with others through the common understanding of symbols in languages, known as characters and letters. Until the dawn of a paper-free society, the primitive communication method, handwriting, will persist, and will play important and convenient role as a means of recording information. So long as the primitive communication method is used, the corresponding handwriting recognition technology will thrive to simulate machine reading of human manuscripts.

Depending on the input methods of handwritten data into recognition systems, handwriting recognition techniques diverge into two flavors, on-line or dynamic and off-line or static respectively. In the dynamic or on-line type method, a special pen is commonly used on an electronic liquid crystal display surface with a sensor to digitize the pen’s motion trails. The motion trails, writings, are stored in order of two dimensional coordinates in timely manner. However, in off-line or static systems, a paper with handwritten data is scanned and digitized through an optical scanner, and only two-dimensional information is stored. The information of stroke order and time is not available in off-line system (Plamondon & Srihari, 2000; Vinciarelli, 2002). However, there are common challenges to be addressed in both methods. They are the variations of human handwriting, such as position, size, slant or slope, different models and connectivity.

The remainder of this chapter describes the ideal applications of handwriting recognition systems, the problems of handwriting recognition, the state of the art handwriting recognition systems and solutions using machine learning techniques.

Handwriting Recognition Applications

Handwriting recognition is a series of processes to interpret clusters of graphical marks on a surface into meaningful symbolic representations of a related language. For an instance of English language, the symbolic representations would be alphabet characters and letters. The importance and need of handwriting recognition has been arising in many real world applications such as postal address recognition, bank cheques processing, hand-filled forms processing, conversion of field notes and historical manuscripts. One of the major applications of the handwriting recognition is automation in processing bank checks for handwritten legal amount (Xu, Lam, & C Suen, 2003). Handwriting recognition systems also contribute very much into automation for processing of postal codes (Alginahi, 2009) and postal addresses (Akiyama, 2004). A highly effective application of handwriting recognition is to process handwritten form data (Cheriet, 1995). A vast amount of handwritten historical manuscripts can be easily converted into electronic representation for sharing and searching (Wuthrich, 2009).
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