

Exploring New Handwriting Parameters for Writer Identification



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INTRODUCTION

In the XIX century, Giovanni Morelli -Verona, February 25th 1816–Milán, February 28th 1891- introduced a paradigmatic change in the detection of forgery of famous paintings (Ginzburg & Davin, 1980). Before him, famous picture authentication was based on global indicators such as general illumination, perspective, body position, smiles, and gaze direction, among others. However, such well known characteristics are easy to imitate.

On the contrary, Giovanni Morelli believed that forgeries should be detected watching minor details, such as those less influenced by the pictorial school to which the artist belonged. Every artist automatically produces, almost unconsciously, some details such as nails, fingers, toes, earlobes. These details were considered by Morelli as notoriously revealing, since they appear when the artist's control relaxes and individual impulse take control of his or her actions. Following his conceptual model, Morelli created a large catalog of the minor details of many artists such as Boticelli, Leonardo, Rafael and others. Obviously, trained observers were needed to apply the comparisons advocated by Morelli.

Morelli's method has had a cultural influence over many fields where the search for identifying details began. This change of paradigm led to the use of smaller details in many fields such as people identification. Later, the necessity for better people identification techniques increased. In 1879, Alphonse Bertillon (1893) created an

anthropometric method based on many physical measurements. A few years later, Francis Galton proposed a simpler identification method based on fingerprints. This miniaturization process reached a possible end when started the use of DNA for people identification.

In the specific field of handwriting recognition domain, the evolution followed the same pattern, since old practices, based on global characteristics, such as geometric observable information was replaced by new practices based in parameters which are the result of measurements of smaller characteristics. This chapter proposes some new smaller characteristics, barely observable even by zooming of captured images of the manuscript text.

The automatic processing of handwriting samples is part of the computational biometric. It applies qualitative and quantitative techniques by means of capturing, visualizing and analyzing handwriting. The main applications are writer identification and text understanding. Two significantly different situations appear: on line and off line data capturing. In the former the samples are obtained in a dedicated framework, where the writing instrument and the surface have several sensors. In the latter, the unique information available comes from the residues left on the paper. This chapter deals with the second situation. Width, gray value, direction and other parameters of the residual manuscript text were influenced by the psychomotor characteristics of the writer. Some of these personal parameters may be estimated from the observable properties of the written text.

Any automatic or semi-automatic handwriting recognition process is always composed by at least two activities: i) recognition parameters calculation and ii) comparison of sample parameters with a data bank of registered parameters. Parameter calculation and parameter comparison are quasi independent activities, since almost every parameter set may be used by almost every comparison technique. Very infrequently a better efficiency and efficacy may be obtained by combining certain parameters sets with a given comparison technique. This chapter proposes some new parameters and enhances the understanding of some already in use parameters, leaving the choice of the comparison technique to later studies. The authors believe that the major contribution of the research whose results are presented in this chapter is the better comprehension of the mechanism that creates the residues left on the paper, since some unproven and largely used hypothesis are criticized in some degree.

BACKGROUND

The information recovered off-line from the static residues left on the paper is called pseudo-dynamic. It is clearly different from the actual dynamic information captured on-line during the writing activity. There are many contributions proposing different pseudo-dynamic characteristics, most of them oriented to signature authentication, which is a sub-problem of identification of the author of free text. Some of them are summarized in the next paragraphs.

The work of Ammar et al. (1986) the histogram of the gray level of the signature is analyzed and a pressure threshold is proposed. The signature is described in terms of the percentage of pixels whose gray value that exceeds such threshold, along with other parameters such as the minimum and maximum gray value and the dynamic range of the signature image. Those parameters are compared with a set of signature parameters using classifiers based in Euclidian distance.

A combination of geometric and pseudo-dynamic parameters is used in Huang and Yan (1997). It is based on strokes geometric parameters such as contour, skeleton and the high pressure regions; these parameters feed a classifier based on neural networks.

The proposal introduced in (Fang, 1999), is oriented to geometry; it places the focus on strokes whose size exceeds a length threshold. A softness index is calculated for every one of these strokes. The quotient between the number of soft strokes and the total number of strokes becomes an identification parameter.

A strategy based on pseudo-dynamic characteristics is described in Mitra et al. (2005). It is oriented to the detection of elaborated forgeries. The pressure applied by the writing instrument, estimated by using the gray level of the image, is considered the most relevant parameter. The strategy chooses low pressure pixels as identification parameters. No information about the paper used, the writing instrument or the base where the paper was resting is given.

Another proposal oriented to geometric parameters can be found in Oliveira et al. (2005). It is biased to recognition or authentication of signatures, since it uses parameters not available on free text. Several new geometric parameters are introduced such as the quotient between high and wide, a softness index and inclination in relation with a baseline, among others. Using a similar set of geometric parameters, Lv et al. (2005) propose a Chinese signature verification method. In addition to geometric parameters they include two pseudo-dynamic characteristics: the pixel gray level distribution and the wide of the line. Both parameters are supposed to indicate the pressure applied during the writing process. No indication about the paper, the writing instrument or the base used is given.

In two consecutive articles Vargas et al. (2008, 2011) propose two methods for signature authentication or recognition. Both are biased to signatures. In the first article, the geometric center of the signature is calculated and a polar geometric

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