Open access Journal International Journal of Emerging Trends in Science and Technology

FODEX: Forensic Document Examiner –Using Graphology Science

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Abstract
Forensics document Examiner examines handwritten documents. The proposed system examines document using graphology science which generate a profile report of a person through handwritten text. The proposed system is a pattern recognition system for the organization which is involved in handwriting analysis and Cyber Crime Investigation. FODEX is designed to provide online facilities to the Users who want to verify their handwriting. This enhances the graphology to the next level where users can be across the globe. More specifically, FODEX is designed to provide a user interface which will facilitate easy of analyzing the handwriting samples. The system accepts scanned input image of handwriting and processes it using image processing algorithms and extract features from the image. These features are compared against a standard data set to generate a report about the sample submitted by the person later the generated report is either emailed or printed for the user accordingly. FODEX processes image and extracts features through various processed such as gray scale, threshold detection, RGB splitting, thinning, segmentation, scaling.

Keywords: *Image Processing, Handwriting Analysis, Forensic Document Examiner*

Introduction

Graphology or handwriting analysis is a field of study for identifying and understanding people's personalities, behaviors and characters through analyzing their handwritings. The techniques of graphology are used in numerous applications. The common applications of graphology are employment profiling, marital compatibility, psychological analysis and medical diagnosis. Graphology has been controversial for more than a century. Although supporters point to the anecdotal evidence of positive testimonials as a reason to use it for personality evaluation, most empirical studies fail to show the validity claimed by its supporters.

Forensic document examination involves the analysis and comparison of questioned documents with known material in order to identify the author or origin of the questioned document. Although this is a recognized and called upon scientific technique Forensic Graphology cannot tell a person's age or sex from the handwriting. What it can do however is provide indications of the person's state of mind at the time of producing a particular document, be it a blackmail letter, a poison pen letter or a suicide note. Comparing samples of handwriting does not necessarily give a straightforward unambiguous result. Uncertainties about what may be a style characteristic, the quality of the samples, and the likely degree of variation, means there is often a degree of uncertainty.

The science of graphology is based on empirical research. To determine which handwriting traits correspond to a particular characteristic, graphologists study large numbers of handwriting

samples from people who have been identified as having that characteristic and look for traits that occur more frequently in their handwriting than in that of the general population.

There are two methods in handwriting analysis, namely, the French approach and the German approach. The French approach is also called atomistic or the isolated trait method where the handwriting is broken down into its various components and examined separately. The German approach, also called holistic or gestalt approach, judge handwriting as a whole where one isolated element does not mean anything outside of the context of the complete picture. This approach analyses the sample in terms of the arrangement on the page, the form of the writing and also the movement. It gives an intuitive impression of the entire writing and is able to make certain assumptions about the writer. Neither the holistic nor the isolated method is the "best", but when used in combination, it provides the most complete picture of the person's disposition. Today, professional graphologists use a combination of both methods.

It is believed by the graphologist that graphology works because people add their own characters to their handwriting. When someone writes, his or her emotions and characters are reflected in the piece of writing. The handwriting in turn provides clues containing crucial information on the emotions and characters of the individuals.

Graphology can identify well over 5000 aspects of personality by examining loops, letter spacing, slants, heights, ending strokes, etc. Each symbol in a given handwriting sample is interpreted as a personality trait. Every aspect of a sample is treated, from the text layout to every single letter written. Although graphologists may differ in their opinions and interpretations of criteria, there are some in common.

Related Work

Handwriting Analysis or Graphology is a scientific method of identifying, evaluating and understanding personality through the strokes and patterns revealed by handwriting. Among the many aspects of handwriting that can serve as scheme to predict personality traits are baseline, size of letters, writing pressure, connecting strokes, spacing between letters, words and lines, starting strokes, end-strokes, word-slant, speed of handwriting, width of margins, and others. Writer individuality rests on the hypothesis that each individual has consistent handwriting, which is distinct from the handwriting of another individual. However, this hypothesis has not been subjected to rigorous scrutiny with the accompanying experimentation, testing, and peer review.

The current state of technology is an expanding topic. Many examiners are looking for new software to get more accurate readings from handwriting examinations [4]. Agencies in the private sector and the public sector are willing to pay top dollar for any software that can do an analysis and have accurate readings. The technology is used by forensic teams in all law enforcement agencies, by document examiners, and by private companies as well. The available tools are used to help find out the identity of the writer. The questioned documents are used to find forgeries, similarities and dissimilarities of documents, sign of alteration and the authorship of a given document. There are few types of software that use handwriting samples to ascertain known personality traits.

Unfortunately there are only a handful of systems to showcase at the present time. With technology growing the numbers are bound to get higher and as the need arises to authenticate one's identity, that has sparked more interest within the forensics community to create accurate automated systems that will aide in the identification process.

Table 1: Summary of three Handwriting Analysis Systems

Sr. No	System Name	Description
1	Handwriting University's Handwriting Wizard.	Web-based handwriting analysis system. The system consists of 9 handwriting characteristics. Each characteristic consists of

		one or more questions. Platform independent. It is free. Text-based report type.
2	Sheila Lowe's Handwriting Analyzer.	Stand alone system that applies Gestalt or holistic graphology concept. At least 10 categories of handwriting characteristics must be completed to generate a report. Runs on Windows. Paid software Text-based, graph, bar chart and pie chart report type.
3	Center of Excellence for Document Analysis and Recognition 's CEDAR-FOX[5]	Questioned document examiner to go through processing steps such as extracting regions of interest from a scanned document, determining lines and words of text, recognize textual elements. Compares two samples of writing to determine the log-likelihood ratio under the prosecution and defense hypotheses. The software, which is protected by a United States Patent can be licensed from Cedartech, Inc.

Proposed Methodology

The proposed system gives a prediction of personality of the user from handwriting by making use of graphology techniques. Following diagram shows the flow of the proposed system.

Professional handwriting examiners called graphologists often identify the writer with a piece of handwriting. Accuracy of handwriting analysis depends on how skilled the analyst is. Although human intervention in handwriting analysis has been effective, it is costly and prone to fatigue.

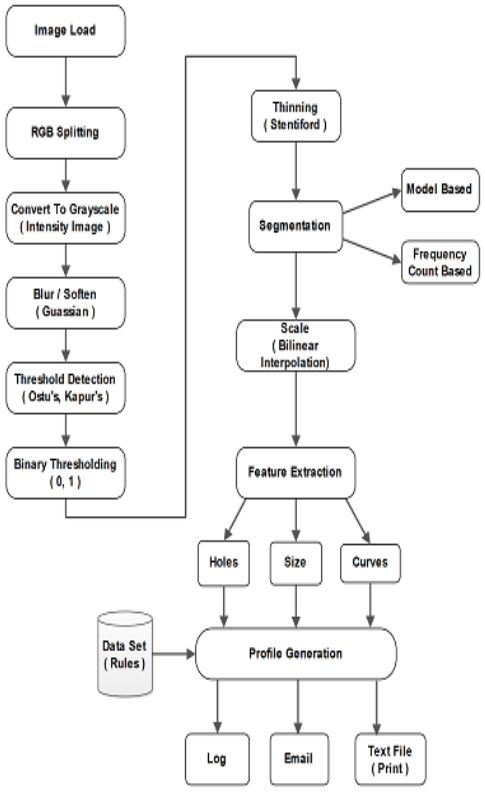

Figure 1: FODEX system

The proposed system FODEX focuses on developing a tool for behavioral analysis which can predict the personality traits automatically with the aid of a computer. The system is designed to analyze scanned images of handwritten documents. The images are converted into binary black and white pixel images. It is difficult for the program to identify different letters, words and lines by pixel analysis without human intervention. Therefore, human decision process guides the system to achieve higher accuracy. Here the aim is to create software that allows a user to analyze handwriting samples, with the aim of making the process faster and more objective.

FODEX working will start from a web page where the user has to enter his/her detail after filling the detail of the system user needs to submit that form after submission of the form user will be provided with the password which user has to use to download the software. Once the login process is successful completed then the software will be available for the user to download. When the software will be in users system they will be provided with a brief history about graphology and

asked to write the data which will be the combination of words and letters. After user writes the document he/she needs to scan the data and submit to FODEX system. The system will then process with the image and provides user profile which could be printed or emailed.

Process which takes place inside the system firstly the image which is uploaded by the user is taken and processed with RGB splitting after this it is converted into grayscale then the blurring process is performed which provides input for the thresholding stage[8 then binary conversion take places it provides input to thinning[9] , segmentation , here with the help of histogram separation of connected letters are separated and finally scaling is performed after the image is extracted it is processed for feature extraction where it is matched with the data base and profile is generated

Future Enhancement

This software system will be a Pattern Recognition System for organization which is involved in handwriting analysis and Cyber Crime Investigation. This system will be designed to provide online facilities to the Users of the 3rd party. This will enhance the organization on the global level as users are also from different places all over the globe. By making this system the organization will have benefits which will make the organization to generate more capital. More specifically, this system is designed to provide a user interface for the user as well as other stakeholders who else wise need to visit organization. The software will facilitate communication between user and organization.

Conclusion

In this paper we present image processing technique which is used to generate user's profile. This profile will be matched with the traits of the graphology which are already defined by the team. The system accepts scanned image from user and convert it to a form from which features could be extracted and profile can be generated. The system works online and it require high speed internet facility. After all this processing the final output is generated and provided to the user in form of print or email

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