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Predicting Human Behavior through Handwriting

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Abstract: Handwriting Analysis is described as a scientific study. It is analysis of human handwriting. The scientific name for handwriting analysis is Graphology. It is a way of interpreting behaviour from peculiarities in handwriting. All that is part of the mind is reflected by an individual in many ways, writing being one. Professional handwriting examiners called graphologists predict the personality of the writer with a piece of handwriting. Accuracy of handwriting analysis depends on the skills of the graphologists. But manual process of handwriting analysis is costly. Hence the proposed methodology focuses on developing a tool for behaviour analysis which can predict the personality traits automatically with the help of a computer. In this paper a method has been proposed to predict the behaviour of a person from the letter slant, letter 'i', 'f', 'a', 'd', 'e', 'g' and so on. These parameters are input to the Artificial Neural Network which predicts the behaviour of the writer.
Keywords: Graphology, Handwriting Analysis, Behaviour Analysis, Artificial Neural Network, Behaviour Prediction

I. INTRODUCTION

Graphology is a scientific method of identifying, evaluating and understanding personality through the strokes and patterns revealed by handwriting. Handwriting revealsthe true personality including emotional outlay, fears, honesty, many others. Each person has handwriting with its own style, moves. Using handwriting analysis anyone can predict of personality and behaviour of person effectively and reliably . Handwriting represents the mental status of a person and handwriting analysis is technique which useful in areas of social skills, achievements, thinking styles, or work habits. Handwriting also depicts the possible ways of a person's transactions with stress. Handwriting analysis isa study of graphic structures which are being generated on the white paper and all the characters of input handwriting are written separately. Professional handwriting examiners called graphologists often predict the personality of a person with a piece of handwriting. The graphologist provides a window to personality structure. By examining all characters of handwriting and interpreting them separately and together the graphologists generates a view writer's character traits. With the help of graphology, handwriting analysts predict the attitudes, qualities, sentiments or postures.

In this paper, a method has been proposed to predict the behaviour of a person from the features extracted from his handwriting. The personality traits revealed by the slant and different characters as found in individual's handwriting are explored in this paper. To predict the actual personality of the individual there are various features, such as slant, size, pressure, upper zone or case(as in I, t, h, S, etc), lower zone (as in g, q, y, z, etc), word spacing, line spacing, page margins, middle zone or case(as in a, o, c, s, e, etc), arcade, garland, angle, thread and wavy line.

Initiallyten characters areconsidered for predicting behaviour. These ten characters are input to the ANN which outputs the personality trait of the writer. The evaluation of the human behaviour is based on the characters on which prediction is available. In this paper, separate characters are detected first.

For this character detection different methods are performed such as after taking input as in image format apply gray scale, threshold, segmentation horizontally and vertically, boundary detection, cropping ,resize in standard size. After this generate template. NETBEANS IDK is the tool used for this purpose with latest version. The performance is measured by examining multiple samples.

II. LITERATURE REVIEW

The introduction to a system for reorganization English handwriting text based on large vocabulary. The proposed method segments complete lines of text lines into single words. The algorithm tested on 541 text lines containing 3899 word and performed correct segmentation rate of 95.56%.

The proposed system for an enhancement method of their previously word segmentation method [7] in [2011] by exploiting local spatial features. The proposed method has been tested on ICDAR07, ICDAR09, ICFHR10 and IAM handwritingdatabases and performs the better result than winning algorithm.

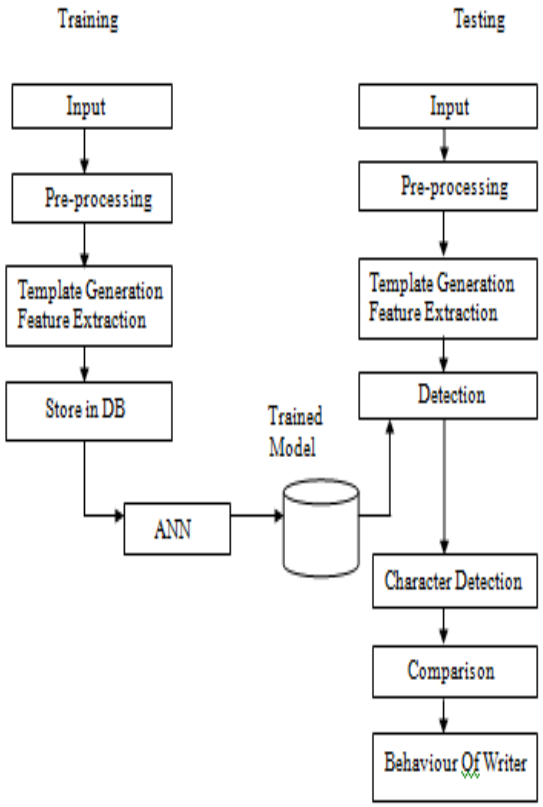
In 2015,The proposed a Personality Identification through Handwriting Analysis. In graphology spacing implies thedistance maintained between the lines, words and letters by the writer. Spacing can reveal various personality constructs like the writer's closeness with people, and also his intelligence. Spacing can be identified into two main groups as wide or narrow as shown in table below:

Sr. no	Type	Personality trait
1	Wide spacing	Discrimination, good taste , independence, isolation, loneliness
2	Narrow spacing	Warmth, sympathy, poor taste, inability to be alone

In 2013, the novel approach to word spacing[8]. If thespacing between words in your handwriting is very wide, it clearly shows that the writer has developed trust issues and therefore he is unable to establish a steady relationship with fellow humans around him. Such writers mostly keep quiet and avoid getting into discussions and arguments.
The Proposedline spacing assumption Line spacing is one indicator ofself-control. The amount of spaceleft between one line and the next establishes how well the writer recognizes the needfor order in her environment and how well she organizes her life. The method has been evaluated on various styles of handwritten text documents, and it is found that itdetects the exact skew angle, and corrects it efficiently with more than 98% accuracy

III. PROPOSED WORK

Handwriting analyst called graphologist analyzes the handwritingon a piece of paper written by the individual writer which is verytime taking. And the level of accuracy in the result is totally depending on the knowledge and experience of the graphologist.



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The system having two modules.First is training module and second is testing module.In training,at first, in our proposed work, the color handwritingdocuments are collected from surroundings, converted togray scale handwriting document.Then sample handwriting images are scannedwhich are written by different writers on differentbackgrounds. Background noise may be generated before or after scanning. Initially noise removal techniques have been applied on the scanned handwriting document. For noise removal linear filtering applied. Filtering is a technique for modifying or enhancing image.Linear filtering is filtering in which the value of an output pixel is a linear combination of the values of the pixels in the input pixel's neighbourhood.

The importance ofusing gray scale images is related to the degree to which colours change between byte values. Grayscale images are best because the shades gradually change from byte to byte. Average method is used for gray scale. In that red, green, blue value of pixel is obtained. By using (R + G + B) / 3 this formula average is calculated.

Thresholding is a process of converting a grayscale input image to a bi-level image by using an optimal threshold... Global threshold technique is used for thresholding. The first stage of the algorithm divides an image into three subimages: foreground, background, and a fuzzy subimage where it is hard to determine whether a pixel actually belongs to the foreground or the Background. Two important parameters that separate the subimages are *A*, which separates the foreground and the fuzzy subimage, and *C*, which separate the fuzzy and the background subimage. If a pixel's intensity is less than or equal to *A*, the pixel belongs to the foreground. If a pixel's intensity is greater than or equal to *C*, the pixel belongs to the background. If a pixel has an intensity value between *A* and *C*, it belongs to the fuzzy sub image and more information is needed from the image to decide whether it actually belongs to the foreground or the background.

Then segmentation is applied. Segmentation subdivides as an image into its constituent regions or objects. It partitions an image into distinct regions that are meant to correlate strongly with objects. In region based segmentation there are a combination of merging and splitting. In our case we need splitting.

Edge detection is an image processing technique for finding the boundaries of objects within images .It works by detecting discontinuities in brightness. Based on texture boundary is detected. Cropping is performed base on the boundary size. Apply the resizing on that character to convert it into the standard size. Using bilinear interpolation resizing is performed. Bilinearinterpolation is an extension of linear interpolation forinterpolating functions of two variables (e.g., x and y) on a rectilinear 2D grid. The key idea is to perform linear interpolation first in one direction, and then again in the other direction.After that template is generated for template matching.Template matching is a technique in digital image processing for finding small parts of an image which match a template image. Then template is store database using serialization. Serialization is the process of converting an object into a stream of bytes in order to store the object.

The character is detected using ANN. First define the initial neurons N, total number of layers i.e3. Then apply the feed forward. Generate a random weight and assigned to the initial neurons. Then calculate the weight of each neuron. Formula for calculating weight

$$\sum_{i=1}^{m} bias + (w^i x^i)$$

The stronger the input, the faster the neuron fires (the higher the firing rates). The sigmoid is also very useful in multi-layer networks, as the sigmoid curve allows for differentiation (which is required in Back Propagation training of multi layer networks).

$$f(x) = \frac{1}{1+e^{-\beta x}}$$

Then calculate error

$\triangle$=OutputB(1-OutputB)(TargetB– OutputB)

Again calculate weight of neurons.

After detecting character behavior prediction is assigned to it.

In testing writers handwriting taken as input and character is detected. This character is matched with the character in trained set. Total number of same character is counted. Behavior of writer is return as output

Thereare number of characters on which prediction was done which is below:

A. Prediction for T character: according to the position of t bar prediction is done.

1) Position of t bar is crossed very high then personality trait is high self esteem

2) Position of t bar is crossed above the

3) middle zone but not at the loop then personality trait is moderate self esteem

4) Position of t bar is crossed very low on the stem low then personality trait is low self esteem.

5) Position of the t bar is crossed above the stem then personality trait is dreamer.

B. Prediction for f character: According to the loop of f prediction is done

1) F having narrow upper loop then personality trait is narrow minded.
2) F loop having angular point then personality trait is resentful, uncompromising.
3) F having angular loop then personality trait is strong reaction against interference.
4) F having cross from then personality trait is concentration.

C. Prediction for i character: according to dot on i prediction is done.

1) The high, flying dot then personality trait is curiosity seeker, impatience, enthusiasm
2) The round and justly placed dot then personality trait is detail conscious, accurate , precise and concentration
3) Absence of dot then personality trait is careless , absent, minded
4) Circle of dot then personality trait is frustrated, attention, demanding, imagination, artistic.
5) The left faced dot then personality trait is neurotic
6) The right faced dot then personality is observant.

D. Prediction for a character: according to the lowercase closed

1) Closed at the top and on the right: it reflects introversion, prudence, cautiousness, personality with ability to reserve what must not be disclosed, keeps secrets, controls his emotions.
2) Closed on the left: introversion, shyness, reflection, prudence, cautiousness, pride, inner life, distrust, and little social contact.
3) Closed at the bottom: When the graphology is fast, legible and clear, it is interpreted as agility for thinking, ability for synthesis and planning
4) Closed with a final curl on the right: diplomacy, ability for public relations, and cleverness for business as a goal to obtain advantages. Reservation, prudence, discretion, calculating personality, distrust.
5) With a small inner curl: (minuscule initial curl, located on the superior area) looks for compliments. Desire for caress.
6) Closed with double curl: (it looks like the oval is formed by two “e” letters). Desire to be liked, to enchant, adjustable passive conduct. Ability to negotiate and for public relations. It may be interpreted as a confusing letter, depending on the rest of the graphical context: hiding.
7) Closed by double turn: diplomacy, reservation, prudence, cautiousness, lies, egocentrism, intrigue, interested expressions. If the oval is divided: commercial skills, diplomacy, and astuteness
8) Closed and pasted: hysteria, stress, accented mental or physical fatigue, mental confusion due to emotional disorder, may be due to intoxication with alcohol or drugs.

IV. CONCLUSION

A method has being developed to predict the behavior of a person from the features extracted from his handwriting. The personality traits determined by letter slant, letter ‘i’, ‘f’, ’a’, ’d’, ’e’, ’g’ and many others as found in individual’s handwriting are explored in this paper. This are input to the ANN which outputs the personality trait of the writer.

V. FUTURE WORK

The future work can include more handwriting features with the proposed method with cursive handwriting andobtain the more robust system

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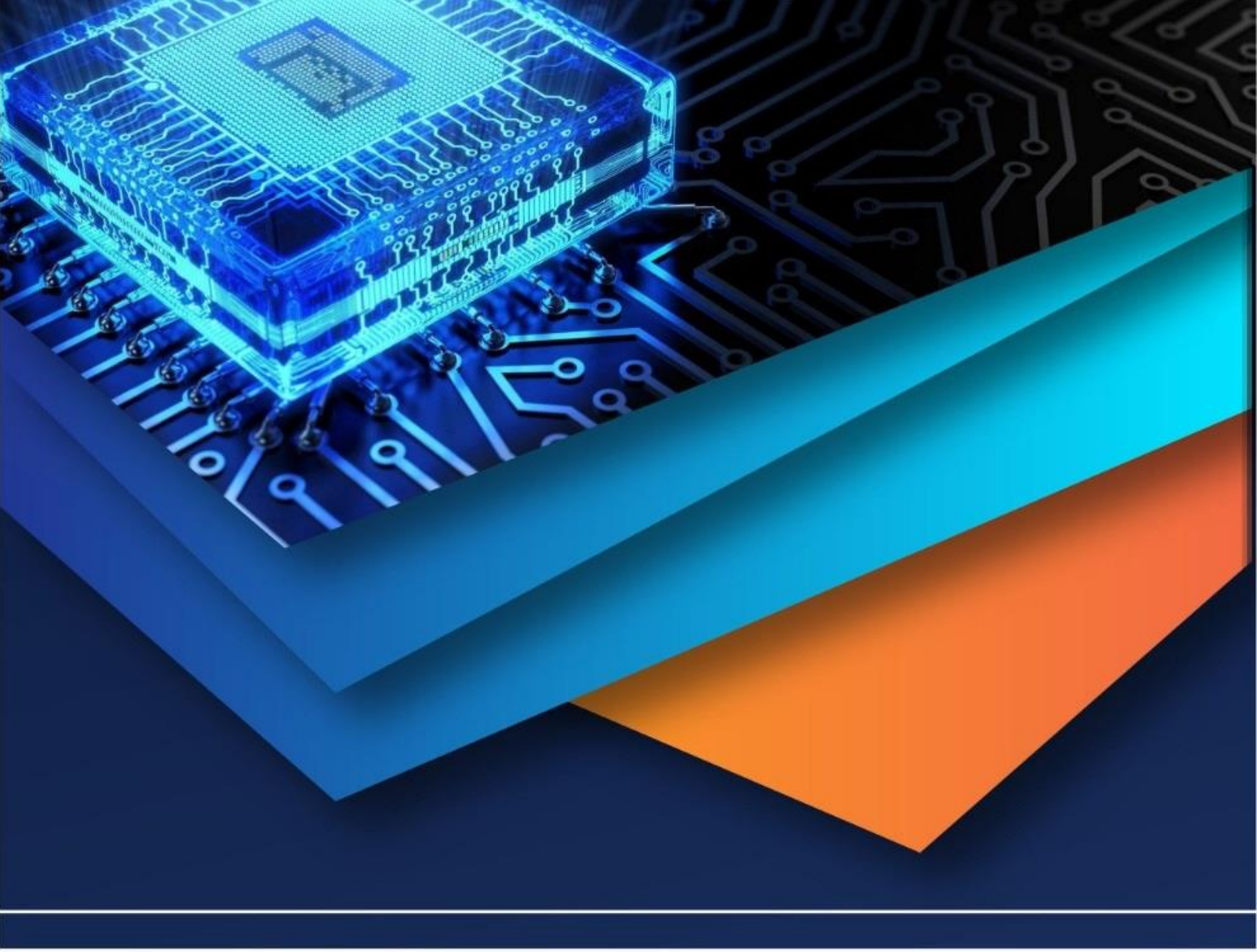

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