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Identifying Human Behavior Characteristics using Handwriting Analysis

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Abstract - *Computer Vision seeks to emulate the human vision by analyzing the digital image inputs as the human perception does. To detect an emotion will not be a difficult task for the human but for any computer, detecting an emotion will be a difficult job to perform as it is unaware of the human nature. Human Behavior can be detected by different forms like Facial Expression, Human Eye Tracking, Web Mining; etc. These methods have been useful from the past years to predict human behavior. This data has proved to be very useful for business and marketing purposes a lot. Handwriting analysis is described as a scientific study and the analysis of the handwriting. It is a way of interpreting behavior from the peculiarities of the handwriting. The scientific name for Handwriting Analysis is Graphology. The accuracy of the handwriting analysis depends on the skill of the expert called a Graphologist who performs the art of Graphology. The manual process of handwriting analysis is costly and prone to fatigue. Hence the proposed methodology focuses on developing software for human personality prediction by analysis of the handwriting. By observing the different features present in the handwriting like slant, baseline, curve, pressure, etc. the behavior trait of the person is predicted.*

Key Words: Graphology, Handwriting Analysis, Human Behavior, Facial Expression, Web Mining, Human Eye Tracking.

1. INTRODUCTION

Handwriting Analysis or Graphology is an art of finding, analyzing and predicting the human personality. This is possible by studying the strokes and patterns present in the handwriting. This is also called brain writing as one can understand different shades of human personality like fear, honesty, temper, and straight-forwardness and so on. Each personality trait is represented by a neurological brain pattern. Professional handwriting examiners called as graphologists often identify the writer with a piece of handwriting. The 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. Hence the proposed methodology focuses on developing a tool for behavioral analysis which can predict the personality traits automatically with the aid of a computer without human intervention.

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In the existing system of handwriting analysis, there is a demand to use only one type of pen (color of ink is not considered) during the whole analysis, i.e., the system only accepts one type of pen. This restricts the user's level of comfort to some extent. The proposed methodology focuses on using a variety of pen (ball, gel, ink) for the analysis of the handwriting.

1.2 MOTIVATION

The Human behavior prediction concept is an intriguing one. We had researched various topics to predict human behavior. Handwriting analysis is an emerging trend for the prediction of human behavior. Graphologist implements this method but it is more prone to fatigue and less reliable. If we could develop a system which would analyze one's handwriting and predict his/her behavior, then a lot of time could be saved. Therefore, there was a need to implement a way for a better implementation of this method.

2. PROPOSED FRAMEWORK

Professional handwriting examiners called graphologist 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. Hence the proposed methodology focuses on developing a tool for behavioral analysis which can predict the personality traits automatically with the aid of a computer without the human intervention.

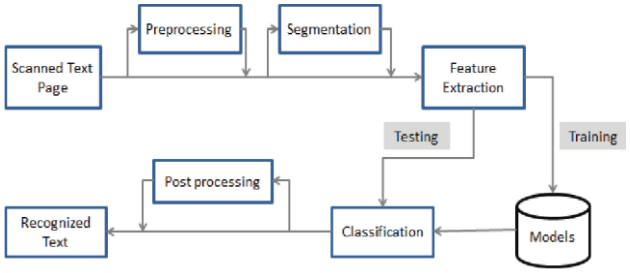


Fig -1: Proposed Framework

3. IMAGE PREPROCESSING AND SEGMENTATION

In pre-processing stage, the handwriting image is pre-processed to remove the noise by applying local thresholding and followed by resizing the sample to the correct orientation. The pre-processing involves opening of the digital image and then smoothing it.

Opening removes the unwanted characters (dots, etc.) in the digital document. The next process is to segment the digital document in various segments, such as word segments, letter segments, and line segments.

Fig -2: Image Preprocessing

4. SET OF FEATURES

4.1 Slant

Slant in handwriting indicates the emotional interactions of the author. There are three classes in this, right slant, left slant and vertical. Along with this some authors handwriting are varying. To calculate the slant in world and letter we use simple trigonometric formula, as below:

$$\theta = \tan^{-1}\frac{y2-y1}{x2-x1} \qquad \text{--- (1)}$$

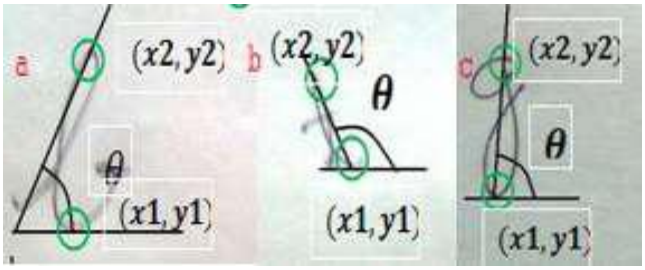


Fig -3: Slant of Letters (a) right slant, (b) left slant, (c) vertical.

4.2 Baseline

The emotional stability and disposition of writer is judged by the baseline in the handwriting as in Figure 4. To calculation this equation (1) is used. In this, line spacing is also considered, which shows that the author wishes to stand back and take a large view of the life.

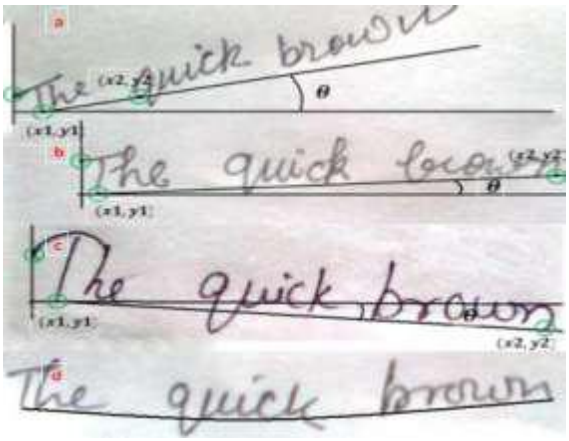


Fig -4: Type of baselines (a) rising, (b) straight, (c) falling, (d) erratic.

4.3 Size

The size of the letters in a document represents the author's desire to be noticed. In handwriting, large and bold writing indicates that the author wants to say "notice me". While in case of small writing author is less desired to be noticed. Middle writing is the normal writing indicating the desire to be fit in the running world.

The size of handwriting is judged by a benchmark of 3mm as normal writing and full height of 9mm. Other than this writing is classified as large or small writing. The letters are divided into three zones: lower case or zone (e.g. g, y), upper case or zone (e.g. b, I, t), middle case or zone (e.g. a, c, e). Figure 5, explains the same more clearly.

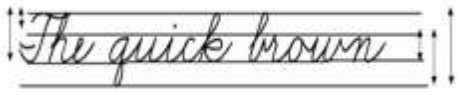


Fig -5: Different zone of letters

4.4 Pen Pressure

Pen Pressure in handwriting shows the physical and mental levels. Heavy pressure indicates commitment and taking things seriously. Light pressure shows sensitivity to atmosphere and also empathy to others. To measure this simple thresholding technique is used. The documents

darker than the threshold value, th_0 , the document is heavy pressure else it is light pressure.

5. IMPLEMENTATION AND RESULT

5.1 Scanning an Image

Scan a Handwriting sample of a person with specific software.

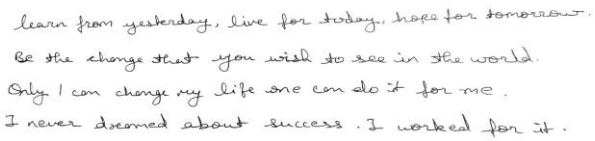


Fig -6: Handwriting Sample

5.2 Image Pre-processing

Includes-Generation of grayscale image, binarization, segmentation, noise removal. All these characteristics in the sample should be removed in order to acquire a clear and sharp image.

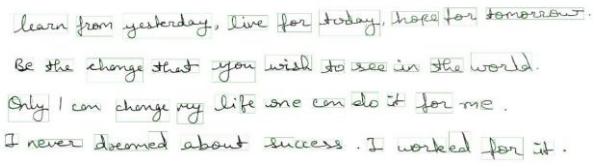


Fig -7: Segmented Handwriting Sample

5.3 Feature Extraction

Feature Extraction is a crucial task that needs to be carried out by experts. Features may be classified as macro or micro features which usually define gray-scale or structural view respectively.

In this step, the writing features such as baseline, slant, pen-pressure, size, margin, zone etc. are determined from the handwriting samples.

In recognition and processing of the data, feature extraction is named to be dimensionally reducing technique and it analyzes the data from a person's handwriting.

5.3 Classification (Using CNN)

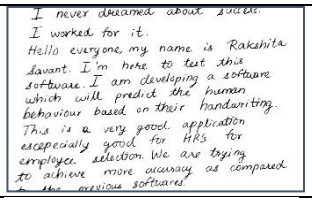
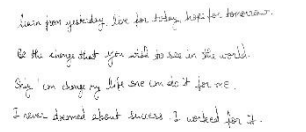
Feature extraction involves reducing the number of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power; also it may cause a classification algorithm to over fat to training samples and generalize poorly to new samples.

Table -1: Personality Traits

Writing Categories	Psychological Personality Behavior
Large Letters	Likes being noticed, stands out in a crowd
Small Letters	Introspective, not seeking attention, modest
Medium Letters	Adaptable, fits into a crowd, practical, balanced
Right Slant	Sociable, responsive, interested in others, friendly
Left Slant	Reserved, observant, self-reliant, non-intrusive
Vertical Slant	Practical, independent, controlled, self-sufficient
Light Pen Pressure	Can endure traumatic experiences without being seriously affected. Emotional experiences do not make a lasting impression
Heavy Pen Pressure	Have very deep and enduring feelings and feels situations intensely.
Raising Baseline	Optimistic, upbeat, positive attitude, ambitious and hopeful
Falling Baseline	Tired, overwhelmed, pessimistic, not hopeful
Straight Baseline	Determined, stays on track, self-motivated, controls emotions, reliable, steady
Erratic Baseline	Wavering, lacks definite direction, emotionally unsettled, unpredictable
Far Spaced Words	Desires more space, enjoys privacy
Close Spaced Words	Closeness of sentiment and intelligence

5.5 Simulation Result

Table -2: Simulated Result

Sr No.	Sample	Behavior
1		Adaptable, Sociable, Optimistic, Responsive.
2		Optimistic, Not hopeful, Practical, Try to avoid energy draining situations.

In this, stimulated result the system shows the behavior of the handwriting sample image after performing all the operation on it.

3. CONCLUSIONS

Thus we have studied the different methods used for human behavior prediction. According to the research, the questionnaire and the survey approach can be a better approach for the human behavior prediction. In this, almost all types and variety of question are asked. Through this using the least square approximation method, Human behavior can be predicted more effectively. For this kind of prediction also, there is no need for the human to be close enough to analyze this behavior. Marketers and researchers who are not close enough can also use this formal approach. This can be regarded as a formal approach to the analysis of human behavior.

In the existing system of handwriting analysis, there is a demand to use only one type of pen (color of ink is not considered) during the whole analysis, i.e., the system only accepts one type of pen. This restricts the user's level of comfort to some extent. The proposed methodology focuses on using a variety of pen (ball, gel, ink) for the analysis of the handwriting.

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