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DETECTING PERSONALITY USING HANDWRITING

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ABSTRACT

Among all the unique characteristics of a human being, handwriting carries the richest information to gain the insights into the physical, mental and emotional state of the writer. Graphology is the art of studying and analysing handwriting, a scientific method used to determine a person's personality by evaluating various features from the handwriting. The prime features of handwriting such as the page margins, the slant of the alphabets, the baseline etc. can tell a lot about the individual. To make this method more efficient and reliable, introduction of machines to perform the feature extraction and mapping to various personality traits can be done. This compliments the graphologists, and also increases the speed of analysing handwritten samples. Various approaches can be used for this type of computer aided graphology. In this paper, a novel approach of machine learning technique to implement the automated handwriting analysis tool is discussed.

Keywords: *Graphology, Personality Traits, Handwriting, Feature Extraction, Margins, Baselines, T-bar.*

I. INTRODUCTION

Handwriting also termed as brain-writing is a useful measure in identifying the characteristic personality traits of an individual. Handwriting analysts also known as graphologists can examine an individual's handwriting to predict the personality traits of the writer. Automated handwriting analysis can be used to examine personal traits of candidates during interviews accurately as the accuracy of an analyst highly depends on his skill set. Also hiring a graphologist to analyse hundreds of samples for recruitment purpose will be time consuming and not be feasible economically. This work discusses about a method for analysing real world handwritten text samples with the aid of technology. The analysis is done for specific features of the sample for determining various characteristic behavioural traits of the person. Various parameters of the handwritten sample like Margin, Baseline, T-bar and Slant will be taken into consideration to determine corresponding traits [1]. The proposed tool will compliment the graphologists to increase their speed and efficiency in the analysis process. Machine learning approach like KNN with incremental learning,will be implemented to improve the efficiency of the tool.

Professional handwriting examiners who identify the personality through the handwriting samples are called graphologist. We can interpret the inner psychology and behaviour through the tone of voice (speech), facial expression, gestures, posture, and manner of dressing. Often, the external style mirrors the inward one. Handwriting is also one of the expressive ways that tells about your nature, psychology and behaviour of the writer.

Handwriting is unique to each individual. And it will be same and unique for a writer whether he/she has written with his/her foot, hand or mouth. Handwriting is written by the brain, not by the feet or hand. So, the handwriting is also called as brain writing. Each personality trait has neurological brain pattern in the human brain. Each neurological brain pattern design delivers one of a kind neuromuscular movement which is the same for each individual who has that specific personality trait. Each stroke or movement in handwriting reveals a particular personality trait. Graphology is the science which identifies these strokes in handwriting and describing the corresponding personality trait. Writer identification is used for various purposes for example, for security, monetary activity, forensic & utilizes as access control, analysis of handwriting documents can be used to judge the culprits in the criminal justice organizations. Handwriting analysis or graphology has wide scopes in the fields such as recruitment, psychology, medical diagnosis, forensic, human computer interaction. Handwriting

represents the personality and behaviour of the humans so it can be used in recruitment and staff selection. The handwriting discloses many things about the writer such as a psychological problem, morality, hidden talents, health related problems, past experience etc.. Handwriting analysis can be used to obtain an insight in to the psyche of the person. Handwriting serves as one of the diagnostic tool. The handwriting reveals the psychological and physiological conditions of the patient; hence it is used as a valuation tool in medical and psychological diagnosis. Earlier handwriting analysis was done manually by spending a lot of time to predict the nature of the person. In manual analysis, accuracy of the analysis depends on the skills of the graphologist. The graphologist is also prone to fatigue when several samples are to be analyzed. For getting a well-experienced graphologist high cost is incurred. At the other hand automated handwriting analysis is very fast, accurate, very low-cost and convenient method in the prediction of human personality.

II. LITERATURE SURVEY

The study of handwriting is quite an old concept tracing back to the seventeenth century. The first book to document these methods was written almost 400 years ago by Camilo Baldi. Known as the father of graphology, Camilo Baldi, who was an Italian doctor of medicine and philosophy, performed systematic observations on handwriting samples in the year 1622. Since then, very detailed and extensive studies have been performed in this field. There are more than 2200 documented studies of handwriting analysis till date.

A study conducted by the American Psychological Association's annual convention acknowledges that the use of computer technology in the field of handwriting analysis can be considered as a reliable tool for determining various traits like honesty, emotional stability, substance abuse risk and judgment. A paper published in the year 1995 at the SUNY, Buffalo by Prof S. N. Shrihari and two others from the Center of Excellence for document analysis and recognitiongeve a lot of insights which led to th in the field of Computer

Graphology focuses only at the prime features of a page of handwritten sample that are page margins, line spacing, line direction, slant and zone ratios. To do this, the methodology used is scanning, preprocessing, feature extraction, analysis and finally, trait determination. This system was mainly designed to prove the validity of the graphology rules that were applied in the implementation of the system. There are no micro features like alphabet, loops etc. taken into consideration. Computer aided graphology which intends to reduce the human intervention needed to perform trained analysis on the handwriting input sample. The features like margin, baseline, size and zones have been extracted through image processing and an approximate analysis of the personality trait has been given. These traits are then mapped to existing theories to determine a final personality type and generate a report for the same. Additional perspective can be provided by using approaches like Natural Language Processing which can improve the efficiency of the system.

A paper based on artificial neural network explores the implementation of a machine learning approach in the field of handwriting analysis. This paper proposed a method to predict the personality traits of a person by analyzing the baseline, pen pressure and the letter „t" as found in the individual"s handwriting sample. These extracted features are then given as an input to the artificial neural network which in turn gives output as personality trait to the user. The future work discussed in this paper are, including more features of the handwriting like the size of the letters and the margins as inputs for personality trait determination to improve the system output[5]. The various algorithms and techniques used for the analysis have been discussed below:

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2.1Polygonalization:

Polygonalization is a method of subdividing the plane into polygons. This is the main technique used to find the slant of the baseline. In this technique of Polygonalization, a closed polygon is drawn around a single line of the scanned handwriting sample. The slope of the polygon in Fig. 1 is found using the coordinates of the polygon. This slope corresponds to the slope of the baseline

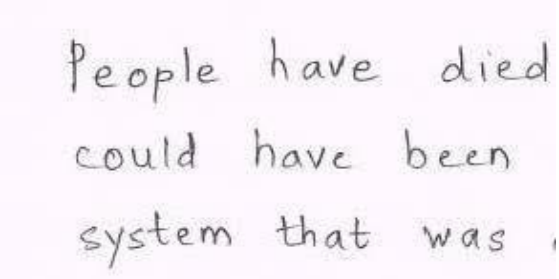

Figure2.1:Polygonalisation

2.2.Thresholding Algorithm:

Image thres holding is an uncomplicated and effective way of partitioning. This image analysis algorithm is a type of image segmentation that segments objects by transforming grayscale images into binary images. Image thres holding is most effective in images with high levels of contrast such like handwritten sample on white sheet using a black pen.

2.3Artificial Neural Network:

When large sample of data is analyzed, different combinations of traits are derived. These combinations of traits are analyzed to predict the personality trait using artificial neural network. Back propagation is the abstraction of the Widrow-Hoff learning rule to multiple-layer networks and nonlinear differentiable transfer functions. Input vectors and the analogous target vectors are used to train a network until it can approximate function is determined which can associate input vectors to output vectors, or classify input vectors in an appropriate way defined by default. This is a flow diagram of the active nodes used in the hidden network. Each input is multiplied by weight (the w N values), and then summed. This produces a single value that is passed through an "s" shaped nonlinear function called sigmoid.

The features like margin, baseline, size and zones have been extracted through image processing and an approximate analysis of the personality trait has been given. These traits are then mapped to existing theories to determine a final personality type and generate a report for the same.Its scope to macro analysis of the handwriting sample. There are no micro features like alphabet, loops etc. taken into consideration.

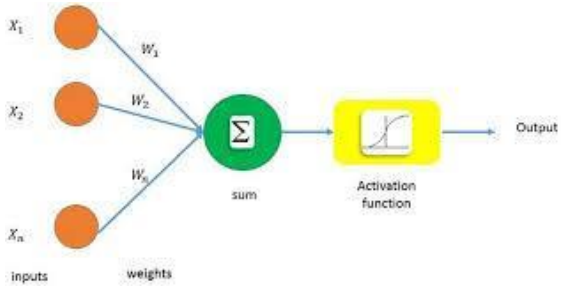

Fig2.3 :Artificial neural network

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III. PARAMETERS FOR ANALYSING HANDWRITING

Graphologists are the handwriting analysts who identify the characteristics traits of a person merely by examining the handwritten samples of the individual. As this is a manual process, the skilfulness of the examiner defines the accuracy. However this is a time consuming and costly affair solely because of the human intervention. Thus, in the proposed methodology the focus would be on the development of a computer aided tool with minimum human intervention that would be able to predict the characteristic traits of a person intelligently. Baseline, writing pressure, spacing between letters, words and lines, size of letters, strokes connecting the letters, width of margins, starting strokes, ending-strokes, slant of word etc. are the most common parameters that help in identifying the personality traits of an individual through handwriting analysis. This paper would be focusing on the following four parameters: Baseline, Letter-slant, Height of the T-bar and Width of Margins.

3.1 Baseline :
The baseline is the feature which reveals a great deal of information as far as the personality of the writer is concerned. Baseline in a person's handwriting is the imaginary line along which the writer aligns the bottoms of the middle zone letters, when asked to write on a blank paper. Slanting downwards, rising upwards and level are the three most common baselines found in handwriting [5]. Different personality traits are associated with each of the above types of baselines. These characteristic traits are mentioned in the table below.

Table3.1:Baseline Characteristics:

Baselines	**Corresponding traits**
Ascending	Optimistic
Descending	Pessimistic
Level	Balanced

Fig:3.1:Types of Baselines:

The technique that would be used to determine baseline, in this paper is polygonolization. In this method the smallest possible polygon around the line to be examined is drawn. This polygon should cover every point on the line. The slope of various sides of this polygon will help us identify the baseline.

3.2 Letter Slant:
The slant of the letter is used to understand whether an individual's handwriting is inclined towards the right or towards the left or is it vertical. It has been observed that, around 77 percent of individuals write with a right slant, 15 percent with left slant and remaining 8 percent write vertically [9]. The slant of an handwriting is in relation to an individual's emotional direction and degree of sentimental control. The writer's connection between the inner and outer world is indicated by means of the slant of the letters.

Table3.2:Letter slant characteristics:

Slant	Corresponding trait
Left	Independent
Right	Expressive
Vertical	Head controls over heart

To determine the slant, the following method is proposed. In the grid of every individual letter that would be obtained after template matching, a line will be drawn between the lowermost and the uppermost points of that letter. Slope of this line will calculate and similarly it would be calculated for all other letters. The average of all slopes calculated will give the slant of letters.

3.3.Height of 't' bar : Another important feature that reveals lot of accurate information about the writer is the lower-case letter 't'. There are different ways in which a lowercase 't' can be written.This would be specifically focusing on the height of the t-bar. The t-bar can cut the stem of the letter 't' at different positions like the lower-portion, mid-portion, upper-portion of the stem or not cut the stem at all. Different characteristics traits of a writer can be identified depending on where the writer crosses the t-bar . These personality traits are mentioned in the table below:

Table 3.3:'t' bar characteristics:

Position of 't' bar	Corresponding traits
Crossed very high	High self-esteem
Crossed just above the middle zone	Moderate self-esteem
Crossed very low on the stem	Low self-esteem
Crossed above the stem	Dreamer

Fig3.3:Types of 't'bar:

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Through template matching all the lowercase „t" letters will be singled out and compared with the predefined templates. 4 templates of letter „t" will be predefined each consisting of t-bar at a height very low on the stem, at mid level on the stem, at very high height on the stem and out of the stem respectively. The given template will be matched with the predefined ones using Hamming distance. Hamming distance will measure the minimum number of substitutions required to change one into the other. The predefined template which is achieved with minimum number of substitutions on the input template will be the matching template

3.4 Margin:

The margin is generally considered to define the layout of the page. Any individual assumes a particular margin while writing on a blank paper. The blank spaces on the left, right, top and bottom on a page comprises the margin. In this paper, different types of left and right margins namely- wide right, wide left, no margin at all and evenly spaced margin will be considered. Following are the characteristic personality traits of individuals associated with the above mentioned types of margin.

Table4: margin characteristics

Margin Orientation	Corresponding trait
Wide left	courageous
Wide right	Avoids future
No margin	Insecure and devotes oneself completely
Even margin	Self disciplined and balanced

IV. ADVANTAGES OF HANDWRITING ANALYSIS

4.1.Handwriting analyzing can tell a lot about personality
4.2 Large companies use graphology.
4.3 The police still use handwriting experts to determine who wrote what.
4.4 Self improvement and professional speaking
4.5 Eliminate risk
4.6 Cost effective
4.7 Decrease staff turnover
4.8 Avoid costly dismissals
4.9 These are the only psychometric tests which generates Honesty Results
4.10 Avoid internal pilferage
4.11 Accuracy
4.12 Better insight into your company branches abroad-only need 1 page of faxed writing
4.13 Win-win situation
4.14 Adds value
4.15 Confidential & discreet-don't meet candidates face to face
4.16 Results can be generated in a day
4.17 Fee pays for itself
4.18 With increase no .of features,we will get better results and effective
4.19 Also,on comparing two classifier output,we will see that which classifier is better in terms of efficiency and matched to real world scenarios.
4.20 We will check the compatability between two people so it is going to tell that they are good for team work or not.
4.21 We can check that if a person is able to handle pressure or not in case of difficult situation.
Onecan know about the potential ,strengths and weakness by getting by getting this analysis done.It can therefore assist or guide in identifying the career choices which are suitable for your style and needs.

It also helps you to identify the hidden talents and aptitudes. Thus helping you to choose a right career path for yourself.

For appraising personality and the job fitment Graphology is objective, fast and accurate. As long as the writing is expertly analyzed and interpreted with a specific job situation in mind, graphology is equally reliable than any other character assessment technique.

Ideally there should not be any effect on the derivation and interpretation, with the fact of writer being left-handed or right-handed. It does not matter even if he wrote it with his/her foot or mouth. It's the brain that commands the handwriting to appear in a certain manner, not the hand.

Graphology can be used for career counseling, checking compatibilities, improving productivity and in understanding and developing one's own personality.

V. LIMITATIONS OF HANDWRITING ANALYSIS

Handwriting is an art and science of analyzing and interpreting personality traits and behavioral patterns and nothing beyond that. Handwriting is the language of our personality just as our face, body; speech and actions have a language.

Handwriting is the writing of the brain. It may vary as one's mood varies but since basics of one's thinking; attitudes; feelings and behavior remain same in whatever mood one carries, handwriting has certain fixed features too, despite such variables impacting it.

Graphology is the study of all graphic movements, not simply handwriting analysis. In addition to handwriting (as popularly believed) graphologists also study doodles, drawings, sculptures and paintings to gain an insight into the physical, mental and emotional state of a writer or an artist. Now the question arises why handwriting analysis has gained so much popularity? Reason is obvious: Practicality.

Since nearly everyone writes, but not everyone draws, sculpts or paints.

VI. CONCLUSION

This paper has proposed a methodology to predict the accurate personality traits of an individual from the features extracted from handwriting using a machine learning approach. This paper explores the personality traits revealed by baseline, margin, slant of the words and height of t-bar of a person's handwriting. These features will be extracted from the handwriting samples into feature vectors which would be compared with an initially trained data set; and then mapped to the class with corresponding personality trait. The baseline would be evaluated using the method of Polygonalization while margin will be calculated using the method of vertical scanning. The height of the t-bar on the stem of the alphabet 't' and word-slant would be calculated using template matching. The proposed system can be used as a complementary tool by the graphologist to improve the accuracy of handwriting analysis and also make the process fast. It will also assist the HR/company employer in decision making regarding the suitability of an employee for the specific job and improving the retention of an employee. The future work can be to include more features from the micro approach of handwriting analysis like the loops of alphabet 'f' and 'l', gradient, concavity of letters and so on in order to predict more accurate results.

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