

# BEHAVIOR PREDICTION OF HUMAN BY SIGNATURE AND HANDWRITING ANALYSIS USING MATLAB

Neha Punetha<sup>1</sup>, Dr. AK Pal<sup>2</sup>, Vaibhav Sharma<sup>3</sup>

<sup>1</sup>G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India-263145

<sup>2</sup>Professor, Departement of Mathematics, Statistics and Computer Science, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India-263145

<sup>3</sup>G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India-263145

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**Abstract:** As in the era of this modern world human values become essential for personality development of human so this paper is designed to predict human behavior through various parameter, signature and handwriting analysis through two new parameters and along with loops of 'i' and 'f' by using various computer oriented techniques and with the help of MATLAB tools such as BPN, SVM as a major tool.

**Keywords:** Signature, SVM, BPN, Graphology

## 1. INTRODUCTION

The study of handwriting analysis and signature analysis is known as graphology that is used for identifying, evaluating personality characteristics of human. Signature is the short depiction of handwriting. Every personality traits of a person is represented by a neurological pattern in brain. These brain patterns produce a unique neuromuscular movement which is similar for every person who has particular personality trait. While writing, movements occur unconsciously. Pen pressure, baseline applied while writing can reveal specific personality traits. Similarly handwriting represents the possible way of mental status and along with this it profiles the human behavior in area of social skills, achievement, thinking styles, or habits. 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 behavior of a person from the features extracted from his/her signature. The personality traits revealed by baseline, pen pressure, height of first letter, length of signature, letter 'i' and letter 'f' as found in individual's handwriting are explored in this paper. In our task, we are examining the handwriting of a distinct person to represent the personality of that person.

### 1.1 System Overview

Professional handwriting examiners called graphologists often predict the personality of a person with the help of a piece of paper. But the accuracy of the results depends on the skills of the analyst. This manual process of signature and handwriting analysis is very costly and time consuming. Hence the proposed methodology focuses on developing a tool for behavior analysis which can predict the personality traits automatically. The various features in signature through which behavior can be predicted are pen pressure, baseline, height of first letter, length of signature, and various parameters of handwriting like height of bar on letter 't', letter 'g', etc. In this paper a method has been proposed to predict the behavior of a person from six parameters- baseline, height of first letter, length of signature, pen pressure, letter 'i' and letter 'f'.

To make signature and handwriting analysis automated we measured six foremost different types of features: (I) Pen pressure, (II) Length of signature, (III) Baseline, (IV) Height of first letter, (V) Letter i, (VI) Letter f and a document to identify the personality of the writer. Segmentation is used to estimate the features from the digital signature in which the letters or words are segmented by means of image processing and put on numerous steps. Signature image is uploaded by the user through MATLAB code and then the images of signature are uploaded, then these samples of signature become digital signature and then it is fed to SVM, which predict the behavior of person. The process of signature analysis is done as shown in the block diagram **Figure -1**.

## 2. DATA ACQUISITION

Signature samples are uploaded to the system. The uploaded image is preprocessed, cropped and resized to the precise orientation. The application allows users to crop images into lines, words, and characters after the images are cropped, the cropped images will be shown on the scratchpad then the cropped image will be loaded.

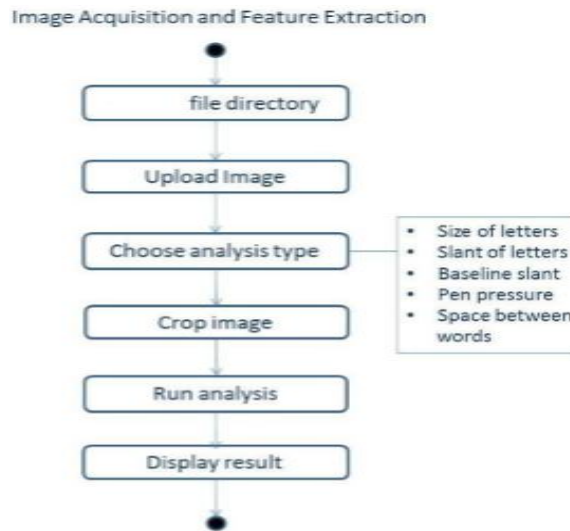


Figure -1: Image Acquisition & Processing

## 3. PREPROCESSING

The preprocessing includes feature extraction process. In this stage, we extract the features of a signature. The parameters which are needed to calculate are as follows:

### 3.1 Pen Pressure

One-of-a-kind of the most advanced major features in a signature sample is the pressure of writing. The pressure applied to the paper while writing shows the perception of feeling, also called emotional attention, of the writer. In order to look at the pen pressure, the scanned images is changed into a grey scale image and mean grey level value is intended by means of the grey level values of the image pixels. Mean grey level value of the image is linked with the pre-determined threshold value,  $th_0$  of the scanned images. The higher value of the mean point to lighter pressure and if the mean is less than  $th_0$ , then the writing pressure is fine thought-out to be high such a person has definite deep and persistent feelings.

So, the conditions of light and heavy pen pressure are

<b>Light Pen Pressure:</b> Mean Grey level > threshold ' $th_0$ '	<b>Heavy Pen Pressure:</b> Mean Grey level < threshold ' $th_0$ '
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### 3.2 The Slant of Baseline

Baseline of Signature discloses a lot of accurate information about the writer. The baseline is the line beside which the signature flows. The trend line that we calculate is called the regression line and this regression line is calculated by means of Least-Squares Linear Regression. For Standard reference angle ( $\theta^0$ ) is well thought-out to be  $90^0$ .  $\theta$  is associated with  $\theta^0$  to classify the slant height. To calculate the slant, the formula is

$$\theta = \tan^{-1} \frac{(y_2 - y_1)}{(x_2 - x_1)}$$





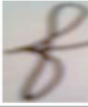
After going through various researches and through psychological facts on human behavior we made following table shown below.

**Table -1:** Personality Traits Predicted by Various Signature Styles

Signature Categories	Psychological Personality Behavior
Light pen pressure	Person can bear traumatic experiences without being extremely affected and emotional experiences do not make a lasting impression.
Heavy pen pressure	Deep thinker and lasting feelings and feels situations extremely.
Raising the baseline	Optimistic, determined hopeful.
Falling baseline	Exhausted, suspicious, not hopeful
Straight baseline	Strong-minded, stay on track, self-motivated, control emotions, dependable, steady
Erratic baseline	Unpredictable, emotionally unsettled,
Far spaced words	Needs more space, enjoys secrecy
Close spaced words	The closeness of sentiment and intelligence
Size of the first letter is capital	The person has more pronounced self- esteem
Size of first letter is small	The person is more grounded
Long length of signature	Reliable, assertive, tedious
Short length of signature	Quick reaction, impatience, weak concentration
Dot follows signature	Highly disciplined person
Signature with loop	Independent, reserved, willful person
Wavy signature	Flexible, diplomatic
The last letter of the sign is small	Lose interest at final stage
The last letter of the sign is bigger	Active at the final stage



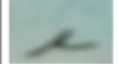



The letter 'f' describes the organization and planning ability. **Table-2** shows the various formations and corresponding personality traits.

**Table -2:** Formation of f personality traits

Formation of 'f'		Personality Traits
	Narrow upper loop	Narrow-minded
	Angular Point	Resentful, uncompromising
	Angular Loop	Strong reaction against interference
	Cross Form	Concentration
	Balanced	Well-organized, managerial ability

Fifth parameter i.e. the formation of letter 'i' provides a lot of accurate information about the writer. The 'i' is the only letter in English language that refers solely to the writer. **Table -3** shows the common formations of 'i' and the corresponding personality traits.

**Table -3:** Formation of 'i' and personality traits

Letter 'i'		Interpretation
	High, Flying dot	Curiosity seeker, impatience and enthusiasm
	Round, justly placed dot	Detail conscious, accurate, precise and concentration
	Absence of dot	Careless, absent minded
	Circle	Frustrated, attention demanding, imaginative, Artistic, dislikes routine work, loyal to ideas and standards
	Left-faced dot	Neurotic
	Right-faced dot	Observant

This work is implemented by various processes first by preprocessing and extracting features by using various functions in MATLAB code. The input to the system is a scanned image of a signature sample. The behavioral inspection is done by examining several features such that pen pressure which calculates the emotional state of a person and baseline slant, the slant of the signature size of letters, and then these extracted features of digital signature are fed to SVM which take the input in the RBF form. Then these outputs which we get are a set of behavior personalities of the person.

### 3.3 Support Vector Machines

SVM are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification we used RBF to give input to the SVM basically SVM takes input as a function. SVM gives the better and exact result.

### 3.4 Radial Basis Function

RBF is a real-valued function whose value depends only on the distance from the origin Sums of radial basis functions are typically used to approximate given functions. This approximation process can also be interpreted as a simple kind of neural network. RBFs are also used as a input in support vector classification.

## 4. IMPLEMENTATION

Based on the MATLAB codes and preprocessing techniques to find the features of handwriting we apply the ANN and then predict the behavior of human based on pen pressure. After scanning the signature by PC then, we have to estimate the feature of signature. By executing various MATLAB codes to calculate pen pressure, alignment, etc. The technique which is used to train this is task is the back-propagation algorithm and its methodology, so first we discuss the (MSE) or Mean Squared Deviation (MSD) of an estimator measures the average of the squares of the errors that is, the average squared variance between the calculated values and target value . In mean square error, we examine the mean of the square of error or deviation of output from the target value. It describes a relation between output and preferred output.

$$MSE = \frac{1}{n} \sum_{i=1}^n (Y_i - Y_i^e)^2$$

Where  $Y_i$  = calculated value and  $Y_i^e$  is expected value Mean square error of the signature.

### 4.1 Backpropagation Algorithm

In 1969, a method for learning in a multi-layer network, back-propagation, was designed by Bryson and Ho. The Backpropagation Algorithm is a practical approach for separating the contribution of each weight. Back-propagation algorithm is used in multilayer feedforward network based upon gradient descent learning rule. The main objective of back-propagation algorithm is to assign the right weights to these superiorities.

### 4.2 Mathematical Formulation

Error signal at the output of neuron 'j' at iteration n

$$e_j(n) = d_j(n) - y_j(n)$$

This process is repeated until the output error established standard result. Hereafter implementing various MATLAB code we get following resulted value of the executed code e.g. after code execution for Mean grey level (pen pressure). We get outlook as shown in **Figure -2**.

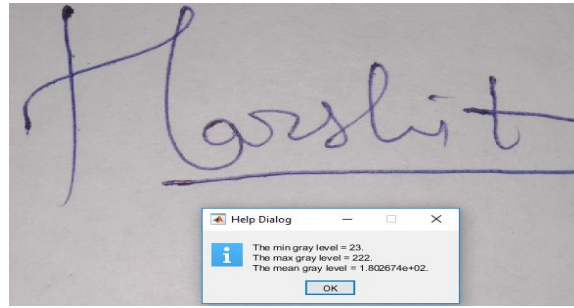


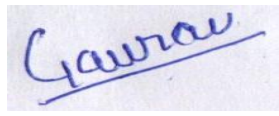
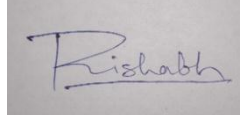

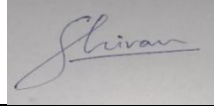

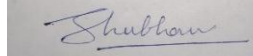
Figure -2: Pen Pressure


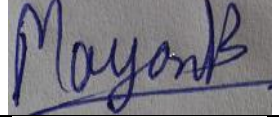

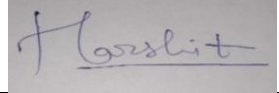
After various techniques and using various MATLAB codes we find the value of various parameters like alignment, pen pressure, etc.

### 5. RESULT

This paper concludes that we can easily predict human behavior with the help of handwriting and signature analysis. In this paper we had considered 6 factors for signature analysis and signature of 10 persons were taken and then with the help of MATLAB code we find the numeric value as shown in **Table -4** and therefore while applying various MATLAB those values are fed to SVM which use to predict behavior. BPN is used to train the network then predict it.

Table -4: Resulted table by combining various parameters

Sr. No	Name	Signature	Mean Square Error	Pen Pressure	Alignment	Height of the first letter	Length Of Sign	Behavior
1	Gaurav		0.5642	2.825	0.371	0.9	4.1	Cheerful , Positive attitude,
2	Rishabh		0.6484	1.856	0.117	0.7	3.6	Dependable, Steady
3	Arvind		0.536	2.213	0.423	1.2	3.9	Determined Hopeful
4	Shivam		0.6479	1.748	0.223	1.1	3.5	self-motivated
5	Neha		0.3336	2.448	0.378	0.4	3.3	Determined Grounded , Deep thinking
6	Shubham		0.6506	1.875	0.332	0.5	3.2	Cheerful

7	Mahendra		0.369	2.386	0.399	0.9	4.5	Optimistic, Progressive
8	Mayank		0.6507	1.204	0.266	1.5	4.6	Long lasting effects
9	Himani		0.3434	2.109	0.378	0.4	3.3	Strong-minded, stays on track
10	Harshit		0.6496	1.802	0.221	0.8	4.3	Self-motivated, Enjoys sec

## 6. CONCLUSION

A technique has been developed to predict the behavior of a person from the features extracted from his handwriting. Six parameters, baseline, height of first letter, length of signature, pen pressure, letter 'i' and letter 'f' are input to the ANN which outputs the personality trait of the writer. The evaluation of pen pressure utilizes grey-level threshold value, various MATLAB tools and codes were used. Hence advanced MATLAB codes were used to predict behavior it will be proved beneficial to treat persons accordingly.

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