

## Handwriting Analysis for Disease Identification

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**Abstract**— Handwriting is a tool to understand partially the unknown world of subconscious mind. The motor nerves come into play while writing. Personality trait identification can be done successfully with accuracy through handwriting. A research is done to show new avenues of application of handwriting analysis. Diseases like strokes, Alzheimer’s disease, Parkinson, Dyslexic disorders can be very easily diagnosed well in advance before the onset of the disease. A novel work is carried out to enlighten that, hand writing analysis not only identifies a person’s characteristic traits but also identifies many diseases including brain disorders like Alzheimer’s disease, suicidal tendency and pessimism etc.

**Keywords**—Behavior Recognition; Segmentation; SVM Classifier; Drop Fall Algorithm; Zernike Moments.

### I. INTRODUCTION

What we write comes from the conscious mind. How we write comes from the subconscious mind. Handwriting is about the brain, not the hand. Nerve impulses travel down the arm, into the hand, directing the fingers to maneuver the pen. When the ink hits the paper, it actually reveals the complex inner workings inside the writer’s body mind and spirit. A deeply trained graphologist can spot imbalances in handwriting that reveal imbalances in the body mind and spirit. Automated system is proposed which can identify all these ongoing thoughts in the mind and helps one to identify before the onset of it. The things that are watched in handwriting are the upper loops, the lower loops, the size of the writing, the pressure, if the writing is angular[1] or rounded, where the t’s are crossed where the i’s are dotted the margins and so very much more. Then we stack all the traits together. Many years of compiled studies and research have discovered that everything from pregnancy to schizophrenia, thyroid imbalance to suicidal tendencies, cancer to Parkinson’s, mental illness to nymphomania, and much more can show up in a person’s writing.

### II. STRONG INDICATOR OF A POTENTIAL HEART DISEASE

All are born as natural graphologists. The mind straightaway wanders to the person who penned the writing, conjuring images of someone intelligent, probably well educated, and artistic. On the other hand when a scribbling handwriting is seen then we have a weird feeling about the person. A skilled graphologist can analyze whether it was penned with left

right or paraplegic person. The traits revealed on paper come not from the hand, but from our mind. Our brain send nerve impulses which travel down from arm, through hand and out to the fingers and onto the pen which then splashes the traits that live deeply inside of us onto the paper.

#### A. Heart Impairment



Figure 1. Broken strokes in letter O

From Fig. 1 the letter O is not continuous it is broken. This trait stroke indicates a leakage in the heart and show up in handwriting long before the body shows signs or symptoms and even before it may show in any medical tests.

#### B. Tremors

If one always had rhythmic, beautiful handwriting and it has deteriorated so, it may be due to excessive usage of computers. If there is a tremor or shakiness that is developed in the writing, then this can be one of the numerous indicators found in handwriting. It could be due to serious illness or severe stress.

### III. RELATED WORK

Research on various handwriting styles has been carried. Up-hill and down-hill in the direction of handwriting indicates optimism and pessimism respectively [2]. Another related work on margins [3] was carried. This work reflected the

human behaviour identification based on wide left margin and narrow right margin etc. The third work is on the letter O and T [4] [5] and its psychological interpretation.

#### IV. METHODOLOGY

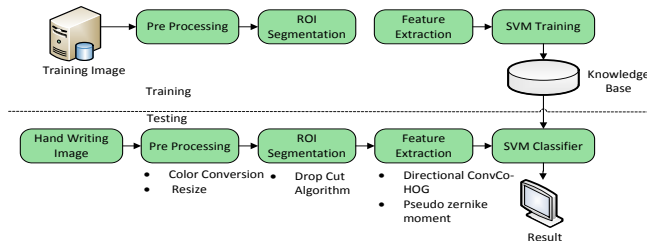


Figure 2. Architecture of the proposed work

This section explains about the procedure designed for handwritten image analysis for the cursive character to identify specific behaviours. Proposed method contains two phases called training and testing phase. Training phase involves learning the handwritten imagery from input samples and extracting their features using directional Convo-Co-HOG and pseudo Zernike moment feature extraction techniques and storing in knowledge base. The key to testing phase is any handwritten character image. Characters are segmented using drop fall technique and features were extracted and classified into different classes and psychological interpretation was done using SVM classifier as shown in Fig 1.

##### A. Drop Fall Algorithm

Drop fall algorithm [6] (DFA) is a standard segmentation utilized for identifying the personality due to its simplicity and competency. DFA replicates the falling raindrop which falls in the direction of gravity and rotates along the contour, cut throughout the contour. Then raindrop follows set of rules of association to establish segmentation. The DFA chooses personality pixels from the adjacent preceding pixel as a new pixel of segmentation to delineate. DFA segments through the diminishing raindrop in concave pixel which is a minute curve between a pair of touching digits. Therefore this technique divides the connected character.

##### B. Directional Convo-Co-HOG Feature

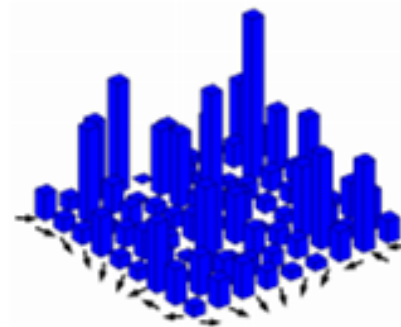
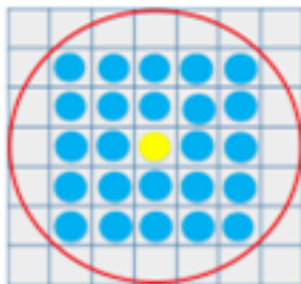


Figure 3. Example of Co-HOG feature extraction: (a) offset used in Co-HOG, (b) one of the 24 co-occurrence matrices of the block of input image containing the yellow pixel corresponding to the offset in (a)

The convolution of Co-HOG [7] is the application of mathematical operation on two functions to produce a third function. In this method an image is divided into  $m \times n$  non-overlapping blocks. In HOG feature descriptor, the descriptor consists of distribution of direction of oriented gradients. Gradients are useful information in an image especially at the edges, where there is a sharp change in the pixel intensity. Thus the shape features can be easily obtained from the edges than from the flat surface. The histogram of the gradients is obtained by applying filtering using kernels. Magnitude and direction is obtained. Every pixel in the image has gradient and a direction. The histogram of the gradient is calculated by using 9 bins from 0 to 160. The contribution of all the pixels are found and histogram is created. The HOG retains orientations of desired pixels and ignore other data with respect to their neighbouring pixels. Then proposed Co-HOG retain rich spatial data by including occurrence of adjacent gradients among pixel pair. Figure 3(a) depicts the relative positions of neighbouring pixels when maximum offset beside both horizontal and vertical directions are to 2 pixels. The yellow pixel at centre of block is the pixel under study and neighbouring blue pixels with various offsets. Each neighbouring blue pixel is the orientation pair with the central yellow pixel and so votes to co-occurrence matrix as shown in Figure 3(b). Thus, if the offset of Co-HOG set is (0, 0), it gives the HOG. Thus, HOG might be attained as a particular case of the Co-HOG.

##### C. Pseudo Zernike Moments

Zernike moments [8] are descriptors of image which has less amount of information redundancy. Pseudo Zernike moments (PZM) are also rotation invariant and have orthogonal properties. Zernike moments are sensitive to noise. But PZM are less susceptible to noise.

To obtain scale invariance there are two methods. One is based on normalization and the other is indirect method. The former method has a flow that the transformation is not exactly for the scaled image. The latter method takes exceptionally long time for polynomial calculation. To solve this problem pseudo Zernike moments is developed.

**V. RESULTS AND DISCUSSION**

**A. Alzheimer’s**

Handwriting deteriorates a when there is a serious mental issues. There will be a drastic change in the writing style. One can find trembles in writing. The writing slows down. Fig. 4 shows the handwriting sample of Ronald Reagan, suffering from Alzheimer.

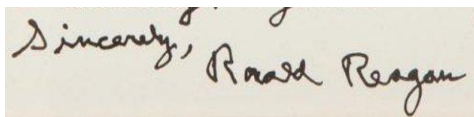


Figure 4. Ronald Reagan’s handwriting, during Alzheimer’s

Severe depression related or schizophrenia is easily spotted in handwriting. The slant changes within the same word or sentence, this indicates the writer has lost the connection with the reality and is in delusions.

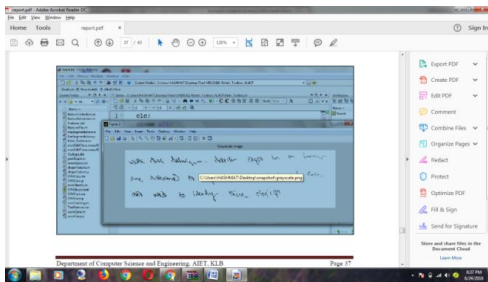


Figure 5. Handwriting samples which shows incomplete words and letters

Fig. 5 indicates the letters which are incomplete [5] which is indicative of Alzheimer’s disease. Such kind of disease diagnosis can be done elaborately.

**B. Downhill writing**

Downhill [6] writing is an indication of a mental illness called as severe depression shown in fig. 6.

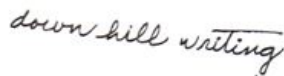


Figure 6. Pessimism



Figure 7. Handwriting samples which shows downhill writing

Fig. 7 shows a handwriting sample which is downhill, this is a case of pessimism, in the sense people takes gloomy way of life.

**C. The crossing of letter T bars**

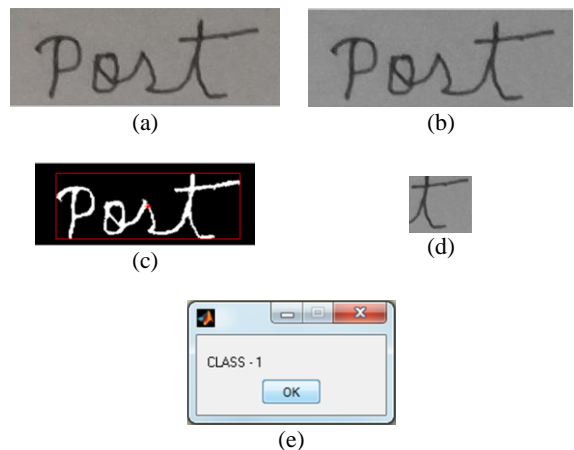


Figure 8 . (a) Original Image; (b) Gray Image; (c) Binary Image; (d) Segmented T-Bar Image;(e) SVM Classified Output



Figure 9. (a) Original Image; (b) Gray Image ;(c) Binary Image;(d) Segmented T-letter Image; (e) SVM Classified Output for Human Behavior

**Table 1: Description and Psychological Characteristic of Classified Class**

Sl.no	Classes	Description	Psychological Characteristic
1	Class-5	T-bar is facing downwards or descending	The person is very stubborn, always holds on his beliefs and ideas, diminishing will, lazy, pessimism, discouragement, inferiority feelings.

**VI. CONCLUSION AND FUTURE SCOPE**

The work carried out, is a fusion of two domains, psychology and computer science engineering. Basically, the problem is identified in the field of psychology and realized

in computer science engineering. Human behaviour is experienced throughout the life time of an individual and hence behaviours are influenced by traits. Understanding the personality trait is a complex phenomenon. They are unchangeable. In any circumstances the same set of behaviour/traits are revealed with few plus, minus. The writer's identification of these traits is of paramount, since these help in analysing handwriting. The analysis is done by graphologists. Specific patterns of handwritings are selected, that reveals personality trait of an individual, by using image processing techniques the patterns are feature extracted, denoised and segmented followed by recognition using SVM classifier or ANN. The Co-relation is indicated between the pattern and the psychological characteristic. Many brain disorders and seizures and epilepsy can be determined using handwriting analysis.

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