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# Handwriting Analysis Using Machine Learning

**Yashomati R Dhumal[1], Prof (Dr) Arundati Shinde[1], Prajakta Mahale[2], Vinaya Kumbhar[2], Mayuri Deshmukh[2]**
[1]Bharati Vidyapeeth (Deemed to be University College of Engineering), Pune, Maharashtra, India
[2]Bharati Vidyapeeth's College of Engineering for Women, Pune, Maharashtra, India

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## ABSTRACT

The culture of humans has modified since digital age where everything may be handled with a tip of the finger, however all those luxuries might return at a value of security or fraud where masking one's identity with a fake one is possible that on the opposite hand isn't possible during a case with handwriting. Handwriting is exclusive to each person like a fingerprint is exclusive to each person. Someone can imitate another person's handwriting for less than a few words creating it unique. Handwriting tells about the character of the person as writing is coupled with brain and it subconsciously leaves a path concerning the temperament attribute like openness, extraversion, consciousness etc., which might be detected. Several forms of handwriting styles are taken into thought like size of word, connecting strokes, left or right slant of the sentence, word space, latter space etc. The complete system assess the handwriting samples based on the above-mentioned handwriting styles and it is divided into four sections with the primary module being the input where the image of handwritten text is taken from the user that is followed by image pre-processing that removes noise and sharpens the difference of the image for better results, that is then passed to the Convolutional Neural Network (CNN) that analyses the input image with the CNN model which is created by performing CNN on the training dataset and classifies the input image accordingly and the last module is the output where the specified images from the earlier module is used to find out the percentage of various types of traits present in the handwriting sample of the subject.

**Keywords :** Handwriting Analysis, Personality, Handwriting Features, Machine Learning (CNN method)

## I. INTRODUCTION

Personality is a unique thing that everyone has. Personalities show how a person acts or quality of that person, both in daily life and at work. Apart from the character that is owned, we can "classify" someone as a person who is conscientious or careless, swift or sluggish in carrying out activities, both professional and daily activities. Tracking a person's personality is important for the company, many companies conduct tests to get the personality of the expected employee in accordance with company criteria. Besides being used for employee recruitment,

personality information is also useful in academics, mental counseling, and forensic information. One way to analyze someone's character through handwriting is called Graphology. Graphology is a technique to analyze one's personality through handwriting, handwriting analysis projects a description of nature in the areas of social skills, achievements, thinking styles, and work habits. Handwriting is a neurologic movement that is typically associated with brain patterns that occur unconsciously, scratches or handwriting are often referred to as "brain writing". The resulting hand strokes define and discriminate one stroke from another, which is analogous with personality traits. Both structural and symbol analysis can be used to analyze trait of personality based on the handwriting. Ongoing technology allows a machine to detect image patterns, signals automatically, and therefore graphology techniques can be used in personality analysis considering the analysis is done on the handwritten image.

Durjoy Sen Maitra et. Proposed to Recognize behaviour from bengali characters. CNN architectures trained as to extract higher level of feature. SVM classifier is used to differentiate personalities. Accuracy is upto 95% using multi algorithm for feature extraction. But has limitations For higher level of feature extraction SVM will underperform.

Prof. Prachi Joshi, et. al's proposed work aims to obtaining personal characteristics traits of individuals especially in age group of 20-35 years. It can be used for graphologists to improve the accuracy of handwriting analysis and also process fast.But Only specifically(T bar)is analyzed using machine learning approach

Patrice Y. Simard et. Al's proposed Paper includes two Paper includes two essential practices 1)General set of elastic distortion that vastly expanded size of training set. 2)Use of CNN. Has limitations in Most of the errors due to writing ambiguities of similar characters.

Champa H N, KR Anandakumar proposed paper that includes MATLAB tool for analysis of handwriting It allows user to select the required character from the input image for feature extraction.Has limitations More features of handwriting like size of the letter, the margins and other features can not be determined Hetesh Mohapatra, et. Al's. proposed a work To design expert system for HCR using neural that can effectively recognize particular character of type format using ANN. In this accuracy in recognizing character 80 to 85%.And limitations Without extracting feature of character complexity of ANN will increase.

Kavitha B.R et. al's prpoposed a work For good recognition results, set a benchmark for offline HTCR (handwritten Tamil character) using deep learning techniques. The work have produced a training accuracy of 95.16% which is far better compared to traditional approaches. Most of the errors due to writing ambiguities of similar characters.

## II. PROPOSED SYSTEM

- To study existing database and to create a novel dataset of handwritten letters from different people.
- To study CNN (Convolutional Neural Network) as a classifier for detection of personality traits and human behavior.

## III. HANDWRITING FEATURES

Graphology is traditional way to analyze handwriting. So to train our database we are extracted five main features and in accordance with this different personality characteristics are determined.

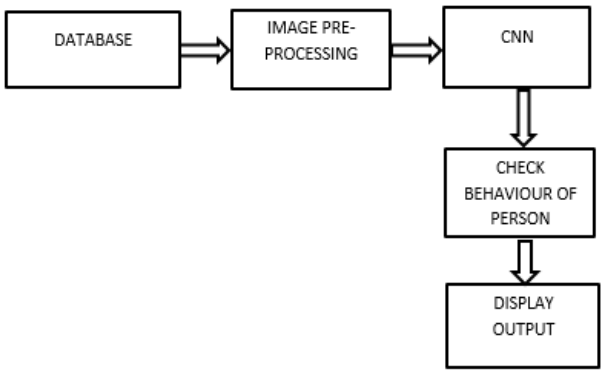
Table 1. Handwriting analysis features and associated personality characteristics.

| FEATURE | TYPE | PERSONALITY CHARACTERISTICS |
|---|---|---|
| 1.Slant | 1.Vertical slant<br>2.left slant<br>3.Right slant | 1. Head over heart emotional attitude, efficient, self discipline.<br>2. sensitive, impulsive emotions influence decisions<br>3. Independent, completely self interested. |
| 2.Strokes | 1.connected<br>2.Non-connected<br>3.Medium connected | 1.Easily acceptable to change<br>2.Monotonous<br>3.Like to change environments |
| 3.Size | 1.Normal or average<br>2.Larger than average size<br>3.Smaller than average size | 1. Balance of mind, realistic, practical.<br>2. Enthusiasm, optimism<br>3. Not very communicate except with close friends |
| 4.Word spacing | 1.Normal<br>2.Narrow<br>3.Wide | 1. Ability to deal flexibility socially mature<br>2. Craving constant contacts, selfishness in demands<br>3. Preferably maintaining distance from social contact |
| 5.Letter spacing | 1. Normal<br>2.Narrow<br>3.Wide | 1.Balanced and flexible relationship<br>2.Introvert,judgement<br>3.Cautions with own feelings |

With reference to the above table we have sorted handwritten data and trained our database

## IV. HANDWRITING ANALYSIS SYSTEM

To analyses the personality from handwritten scanned sample we need to follow some steps as shown in Fig.




### 1) Database:

It is nothing but organized collection of structured information, or data. Here in this case we are collecting handwritten samples of different people to create a database. We have collected 200 handwritten samples of different people having different ages, professions with signature.

### 2) Image preprocessing:

The aim of pre-processing is to increase the quality of the image so that we can analyze it in a better way. By preprocessing we can defeat unwanted distortions and enhance some features which are necessary for the particular application we are working for. Those characteristics might vary for various applications. It includes smoothing, enhancement, segmentation, thresholding.

### 3) Convolutional Neural Network:

A Convolutional Neural Network (CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects in the image and be able to differentiate one from the other

A convolutional neural network is a precompensating neural network that is generally used to analyze

visual images by processing data with grid-like topology. It's also known as a CNN. A convolutional neural network is used to detect and classify handwritten text in an image.

**Layers in a Convolutional Neural Network :**

A convolution neural network has multiple hidden layers that help in extracting information from an image. The four important steps in CNN are:

1. Convolution layer
2. Rectified Linear Unit (ReLU)
3. Pooling layer
4. Fully connected layer

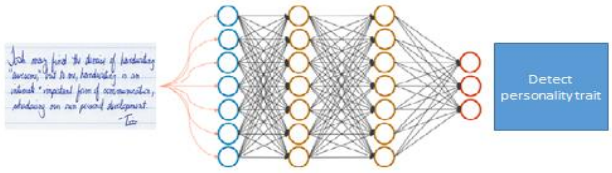
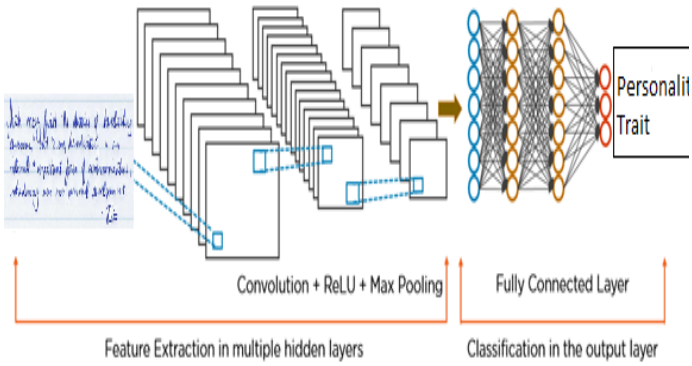



**Figure 1.** Handwritten input image gives personality trait through CNN




Graphology is traditional way to analyze handwriting. So to train our database we are extracted five main features that are slant, strokes, size, word spacing and latter spacing, according to this different personality characteristics are determined With reference to the above table1. we have sorted handwritten data and trained our database.

**4) Detection of Personality Trait :**

Each sample will be having different varieties of handwriting. And according to different handwritings it will have its specific characteristic. When real time handwritten samples is given it will map with trained database. After mapping, when match would be found, the traits of the person can be determined.

**Conclusion and Future Scope**

One handwriting recognition algorithm which is important in improving the handwriting recognition performance is used. This project has proposed a methodology to predict the personality traits of an individual using a machine learning approach. Convolutional Neural Network based algorithm proposed to extract behavioral information from handwritten database. Similarity between the extracted features and a set of reference features is calculated by using CNN classifier. This paper explores personality traits revealed by slant, stroke, size, word spacing, letter spacing. These features will be extracted from handwriting samples which is compared with initially trained dataset &mapped to class with corresponding personality traits.

1. The proposed system can be applied in various fields like tool for graphologists for improving the accuracy of handwriting.
2. It can be used while hiring a suitable employee which is mentally fit for specific job.
3. Accuracy of system is 75 to 80%.

The future work can include more features like pen pressure, gradient, concavity of letters. We can extend work to detect personality online.

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