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Automated Prediction of Human Behavior System for Career Counselling of an Individual through Handwriting Analysis / Graphology

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Abstract

Handwriting Analysis or Graphology is to scientifically finding out, appraising and comprehending an individual's personality based on handwriting. Handwriting is often called mind writing or brain writing. In this paper an automated human behavior information system is presented, which classifies the writers scripts and can predict the personality traits as well as career of an individual automatically with the help of a computer system, without the human intervention by using the science of Graphology (Art of Handwriting Analysis) in which we consider various handwriting parameters including size, slant, word spacing, pen pressure, line spacing, upper zone loops, lower zone loops, page margins etc. over the sets of characters to identify the personality traits related to an individual, which helps in deciding the career of that individual.

Keywords

Graphology, Artificial neural network, Maximally Stable Extremal Region, Handwriting analysis, Feature extraction, Patterns

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Introduction

Handwriting Analysis or Graphology is a scientific method of evaluating, identifying and understanding personality through patterns and strokes revealed by handwriting. Handwriting Analysis is not the examination of document, which determines the author by the examination of a handwriting sample. Handwriting reveals true personality including fears, emotional outlay, defences, honesty and over many other individual personality traits. Handwriting is often called a reflection of a person's brain. There are neurological brain patterns which reflect different personality traits of a person. Each neurological brain pattern forms a radically distinctive neuromuscular movement which is the same for every person possessing that particular personality trait. When a person writes, these very small movements occur without conscious. Each written score or movement brings out a distinguishing personality trait. In the science of graphology we identify these strokes as they appear in handwriting and give an account of corresponding personality trait. According to [6] Gore (2004), graphology is the science of the understanding human mind through person's handwriting. The experts in graphology which are called graphologists analyze most of handwriting analysis. They perform the analysis according to their knowledge and experiences. Therefore, the outcome might vary among graphologists. If a tool is available for the analysis, the non-experts may use it for the same purpose. Handwriting analysis is an efficient and reliable indicator of personality and behavior. Handwriting represents the mental status of a person and handwriting analysis can be a projection technique as being the body gestures that profiles a person's behavior in areas of social skills, achievements, thinking styles, or work habits. Handwriting also depicts the possible options for an individual's transactions with stress. Handwriting analysis is really a study of frozen graphic structures that happen to be being generated inside the author's brain and therefore are positioned on the paper inside a cursive or printed handwriting style that's different from other authors comparing the personalities and their potential for problem solving.

Professional handwriting examiners (graphologists) often predict the personality of a person with the aid of an item of paper. Nevertheless the accuracy with the results will depend on the skills in the analyst. This manual technique of handwriting analysis is incredibly costly and time intensive. Hence the proposed methodology concentrates on making a tool for behavior analysis which could predict the characteristics automatically through some type of computer [1]. The many features in handwriting where behavior may be predicted are pen pressure, baseline, slant, width of margins, spacing between letters, spacing between words, height and width of writing, height of bar on letter 't', letter 'y', etc. A has become proposed to predict the personality of the person from the features extracted from his handwriting using Artificial Neural Networks. Most of researches were done to recognize the characters of handwriting and commonly used Artificial Neural Network (ANN) for the recognition [3]. It is easier to apply neural network for that purpose because ANN is known as a good method for pattern recognition. Any how the training process for ANN requires a lot of time and data.

Motivation

Many people want to know why they should go for handwriting analysis. Handwriting analysis is both important and necessary for us at some level. There are varieties of

reasons why a person must get his handwriting analyzed at least once. The reasons are: handwriting analysis unfolds many things about your personality. It is a tool to know your strengths and weak points [10]. Till about a few years ago, handwriting analysis was restricted to forensic experts. Not anymore. Today, several multinational corporate firms use handwriting analysts to know personality traits of their job candidates. Handwriting tells about your suitability for the job, your motivational level, creativity, leadership, teamwork etc. In fact, I would suggest you to not only get your handwriting analyzed; you should also know the art o handwriting analysis. Advantages are many like having access to the inner feelings of the person sitting next to you, your colleague. It is more productive and beneficial for us to know how to get along with other people and know yourself a little better.

Applications

1. Job Applications

- Getting information about personality of a job applicant without making him aware that he is being tested.
- Finding characteristics of out of town applicants without making them travel long distances.
- Finding strength & weakness of an employee before interviewing process.
- Helps in asking right questions during interview.
- Appointing therapist, baby-sitter, accountants etc. [11].

2. Employee &Teams

- Discovering strengths of individual thus improving teamwork.
- Improving employee performance through direct consultation with HR
- Guide for performance appraisal
- Creating success model by profiling good and poor staff
- Identify best employees during cost cutting
- Help while providing career counselling [11].

3. Personal

- Improving relationships, health, achieving goals.
- Career counselling
- Improving communication with family members
- Choosing gift for birthday celebration [11].

4. Investigation

- Knowing character of business partners and customers.
- Understand the type of person who wrote anonymous letter [11].
- Understanding of the author of threatening letter.
- Understand state of mind of person who committed suicide.
- Understand emotionally unsecure person.
- Eliminate unsuitable jury candidates.

5. Profiling Individuals Not Available in Person

- Profiling the Dead.
- Profiling Someone Hiding or Missing.
- Stealth or Investigation.
- Profiling a Person over a Course of Time.
- Can't Read What They Wrote?

Related Work and Approaches

In Recent years there is much work has been done in automated human behavior prediction system. A literature search shows that most of the related researches have been done in automated human behavior prediction system by following this:

In 2008, Sofianita Mutalib [2] and Roslina Ramli through their research work proposed a methodology to detect personality characteristics called Emotion control through handwriting or graphology. One of the advantages of the technique was that it helped the counsellor that had difficulties in identifying the emotion of their counselee. The study explored the fuzzy technique for feature extraction in handwriting and then identifies the emotion of person. The technique used baseline or slope of the handwriting in determining the level of emotion control whether it is very low, low, medium, high or very high, through Mamdani inference.

In 2009 a researcher named M Pangopoulos [4] presented an automated information system that classifies scripts to corresponding writers using graphology. The methodology was based on the thinking behind making a representative of each alphabet symbol in each script via proper fitting of realizations of the specific symbol from it. The choice for writer identification scaled like pair-wise comparisons of statistical quantities computed for all representatives. The system was placed on ancient greek language inscriptions of classical era of correctly caused by 6 different hands.

In 2010, Champa H N [1] proposed a methodology centering on creating a tool for behavioral analysis that may predict the character traits automatically with your working computer without the human intervention. In their own paper she proposed a methodology to predict the personality of a person in the baseline, the pen pressure, the letter ‘t’, the fewer loop of letter ‘y’ and the slant from the writing as within someone’s handwriting. These parameters were the inputs to some Rule-Base which outputs the personality trait from the writer. We also studied that Forensic investigators use handwriting technology to find out character traits associated with an individual. Different companies use graphology (handwriting analyzing) to evaluate ‘job applications, recruitment, marriage compatibility, and career guidance, motivate workers, and child development’.

Again in the year 2010, Champa H N [9] in her paper proposed a method to predict the personality of the person from your baseline, the pen pressure along with the letter ‘t’ as present in somebody‘s handwriting. These parameters were the inputs on the Artificial Neural Network which outputs the personality trait with the writer. The performance was measured by examining multiple samples.

Through his research paper in 2011 Vikram Kamath [7] presented a with the behavioral prediction of an person through automated handwriting analysis. His work identified the psychological traits inside writing namely size, slant and pressure, baseline, number of breaks, margins, speed of writing and spacing relating to the words. The handwriting was analyzed through Image Processing in MATLAB. The behavioural pattern of the person is predicted through the above traits from the handwriting. The developed system identified handwriting closely which might 't be simple for a graphologist. It is real-time and involves less image pre-processing. The proposed product is calibrated with manual analysis. The outcomes obtained through the system come in good agreement to in excess of 80 percent in the cases with ideal manual analysis.

In 2012 Janet Fisher [8] and Anish Maredia executed an investigation of the several state of the art technologies accessible in analyzing somebody's behavior determined by their handwriting plus the effectiveness of predicting the character and personality of the individual. Additionally they wanted to determine if you can uncover handedness, authorship and gender through analysis. Besides focusing on Lewinson-Zubin technique of analyzing handwriting, various online tools can be found for handwriting analysis, including: NEURO SCRIPT, WANDA, CEDAR-FOX, and Gaussian Mixture Model.

In 2013 Abdul Rahiman M and Diana Varghese proposed a technology aiming at implementing an off-line, writer independent handwriting analysis system 'HABIT' (Handwriting Analysis Based Individualistic Traits Prediction) which acted to be a tool to predict the nature of a writer automatically from features extracted from the scanned image on the writer's handwriting sample given as input. The features include slant of baseline, pen pressure and slant of letters and size writing. The implementation uses Java and Eclipse-Indigo as tools.

From previous literature works, it appears that there are many research studies exploiting various techniques blended with automated human behavior prediction system/ Graphology. Moreover we observed through this literature reviews that human interaction is still needed in handwriting analysis.

Proposed Methodology

Professional handwriting examiners called graphologists often predict the personality of the person by making use of a piece of paper. Though the accuracy in the results depends upon the skills from the analyst. This manual procedure for handwriting analysis is quite costly and time intensive. Hence the proposed methodology targets creating a tool for behavior analysis which could predict the personality automatically with the aid of a pc [5]. The many features in handwriting whereby behavior is usually predicted are pen pressure, baseline, slant, width of margins, spacing between letters, spacing between words, measurements writing, height of bar on letter 't', letter 'y', etc. A may be proposed to calculate the personality of the person on the features extracted from his handwriting using Artificial Neural Networks. Most of researches were done to recognize the characters of handwriting and commonly used Artificial Neural Network (ANN) for the recognition [15]. It is easier to apply neural network for that purpose because ANN is

known as a good method for pattern recognition. Anyhow the training process for ANN requires a lot of time and data.

Input Database

We have taken two types of samples to build the database; the first one is the text type in which some text is written by several writers with different writing styles. The second one is several single alphabets.

1 Text Samples

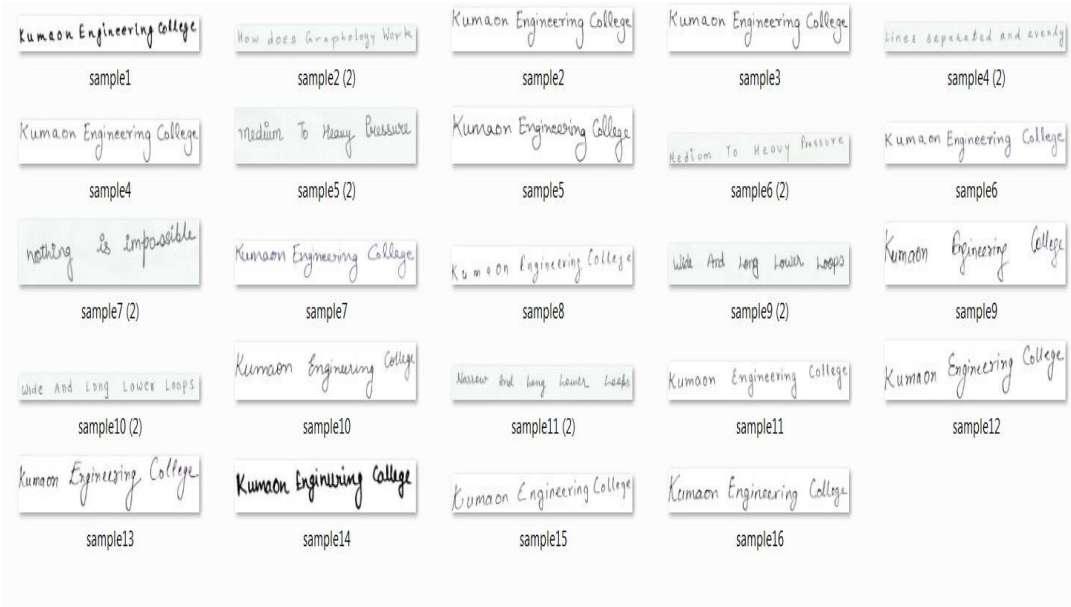

Figure 1: Samples of Some handwritten Sentences

2 Alphabets Samples

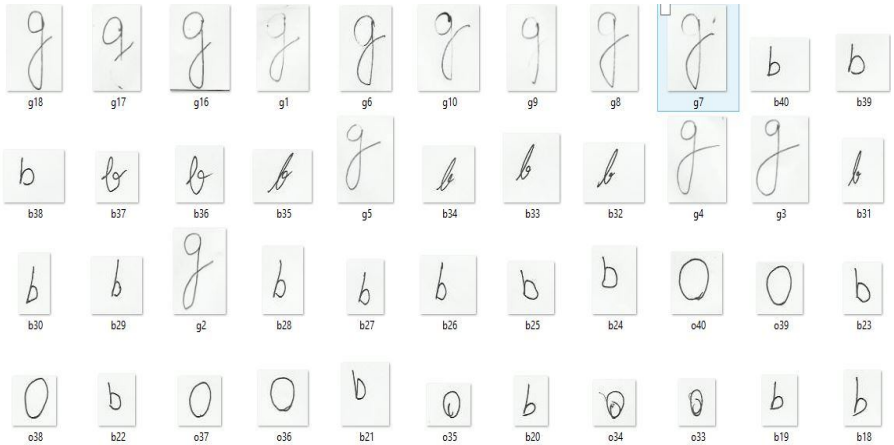

Figure 2: Samples of Some handwritten Alphabet

Detailed Description

This work has been carried out to implement multi-input multi layered Neural Network (parallel distributed system) when considering recognition of Punjabi characters, that is trained using back propagation, for that final utilization of this trained network to realize the patterns trained for, and classify these under different, distinct output classes how the network was taught to group them under.

This problem is divided into two phases:

1. Reading a windows image format
2. Development of Artificial Neural Network model.

Second phase is further divided into two sub-phases:

a. Training phase of neural network
b. Testing phase of neural network.

Implementation

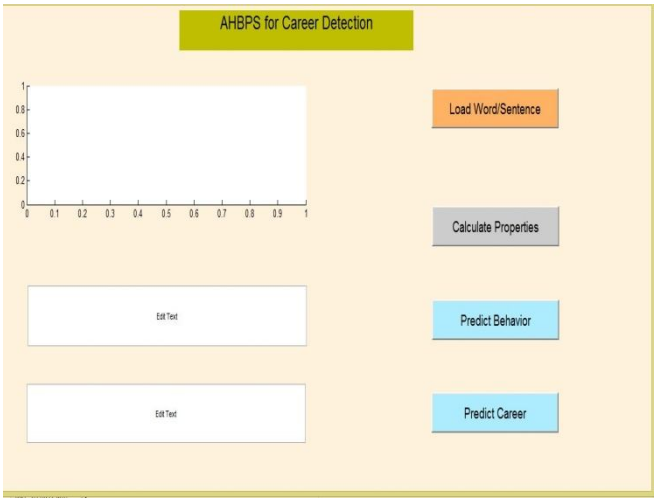

Figure 3: APHBS System Architecture

Problem In Recognition of Characters

Neural network can be not invariant to translation and scale change. The images have to be pre-processed first to achieve the property of translation and scaling invariance. For recognition of character images, firstly the image needs to be pre-processed to ensure that extra noise can be taken off. After removing of noise, the character features are extracted to classify the characters. Just for this recognition scheme, neural net should be trained [17]. The luxury of using neural net for recognition is that different character styles can be easily recognized. Using algorithms, your characters you can get in database can be recognized. This chapter defines the situation statement and describes the implementation with the neural network within the reconstruction of image [16].

Furthermore, neural net also assistance to hear the truth of the reconstructed Gurumukhi characters drawn by different users.

Recognition of Characters

As defined in previous chapter, the problem of recognition of characters can be solved using neural networks. A scheme is proposed to recognize characters from image [14]. Using neural network, recognition of characters is done in following steps:-

1 Load Image (Word/Sentences)

Firstly, input digitized image. Further, this image is used to recognize characters. Figure represents the step of loading of image.

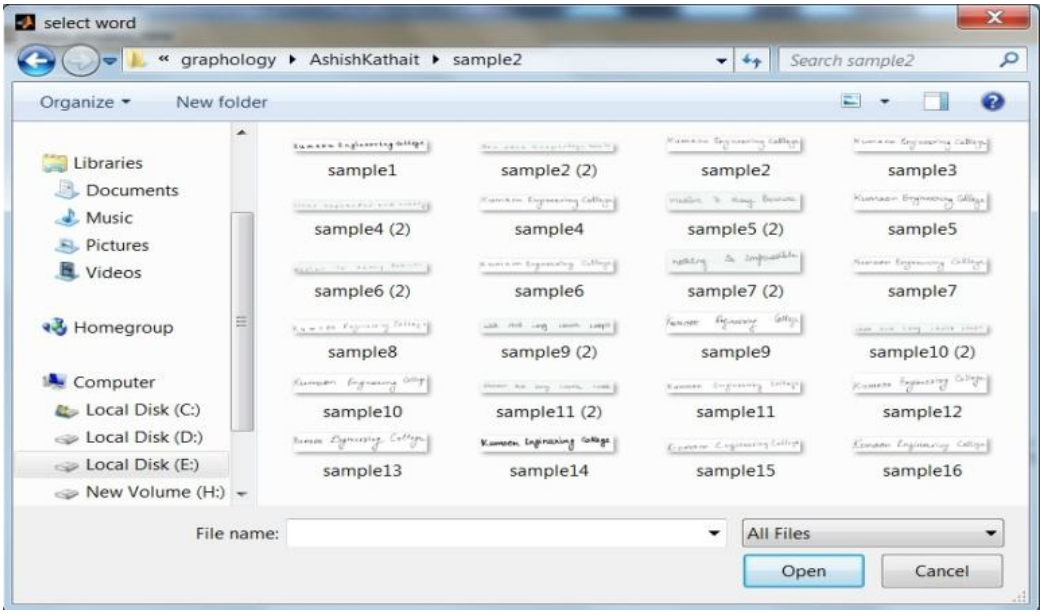

Figure 4: Load Image

After loading, a window opens. This window is used to specify the path where the character image is located. After this process, the image is shown. After loading of image, selection of character is performed.

Pre-processing (Calculate Properties of the Text)

After collection of a specific character, that character is pre-processed. It refers to way of enhancing contrast; removing noise and isolating regions whose texture indicate a chance of character information. In pre-processing stage it is being normalized and removing all redundancy errors in the image and sends to next stage [10][19]. List of figures will be shown which contains of the segmented words that are extracted from the text which then store in the folder which later on match with the database image samples. There are several properties that are extracted from the text which are discussed in the next topic.

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The following are main pre-processing steps:-

a) Firstly, that character is cropped i.e. extra pixels are removed from the character image.
b) Then, that RGB image is converted into Gray scale image.
c) After that, edges are finding out of that character.
d) Extra holes fill up from that character.
e) Bounding Boxes are made up of all characters. These boxes represent the area of whole character.

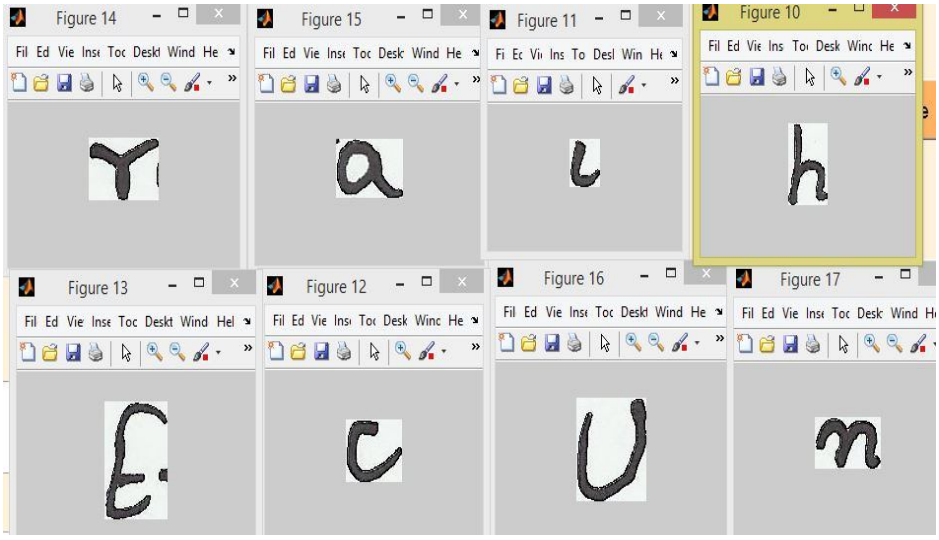

Figure 5: Cropped Character

There are many more cropped characters but we are showing few of them.

Feature Extraction

After pre-processing of character, options that come with character are extracted. This step is heart in the system. This step assists in classifying the characters depending on their features. In fact, the issue in APHBS strategy is the larger variation in shapes in a class of character. This variation will depend on font styles, document noise, photometric effect, document skew and poor image quality. The large variation in shapes causes it to become challenging to determine the number of features that are convenient prior to model building. Though many varieties of features are actually developed and their test performances on standard database are reported.

The following figure represents feature extraction of character:-

Name	Value
average_normal	9
cp	622x1 struct
heigh	249
leng	1541
max	133
min	42
no_of_object	19
original_length	1541
word_gap	10

Figure 6: Extracted features of character

Structural features should be chosen keeping in mind that the shape variations should affect feature set minimally. It was not an easy task to decide which structural features should be chosen to extract the structural features from degraded characters of English script due to large shape variations in characters of the same class.

Predict Behavior and Career

The last in after feature detection is to predict the behavior on the individual. After calculating various values of the text like Word Gap, Number of Objects, Slant, Length and Height we store them in a mat file [1]. Further based on the category- career table which is shown below we can classify that individual on a particular category and can predict his/her behavior and career.

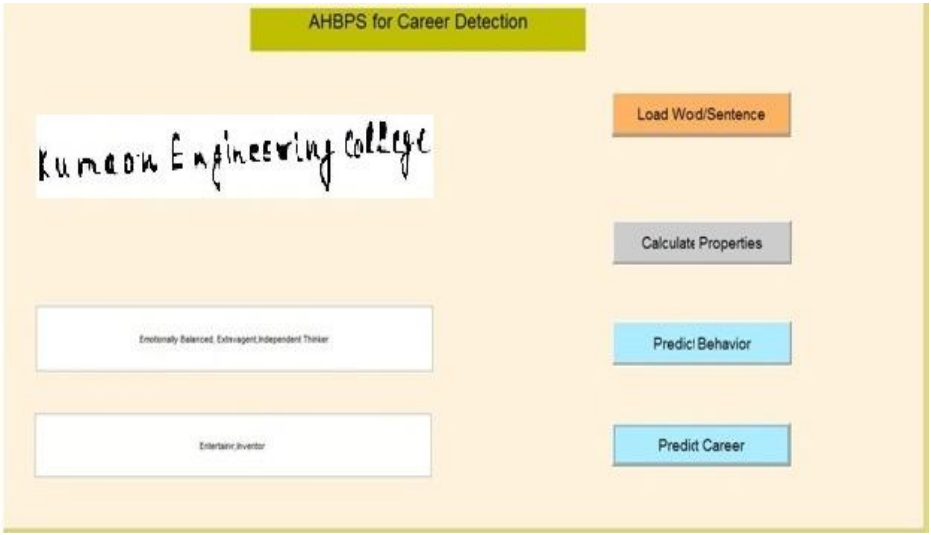

Figure 7: Final Interface showing Behavior and Career

Algorithm Implemented – for a Single Alphabet

```
Algorithm Implemented – for a Single Alphabet

Conventions used
I: image name
P: source data
T: target data

Steps Involved
Step1.  While images in file
Step2.  I <- Read image files
Step3.  D <- rgb2gray I
Step4.  I <- resize
Step5.  Detect endpoints using Harris
Step6.  End while
Step7.  Save files
Step8.  Load saved file
Step9.  P <- create source
Step10. Find end points of target image
Step11. S <- create target data
Step12. net<- newrbe(p,t)                    // create exact radial basis network
Step13. o <-sim(net,P)                       // simulate network
Step14. If o matches input image
            Show image
            Display properties associated with text
Step15. Else check other images
Step16. If not found display error message
Step17. End if
```

The input somewhere can be a scanned image of an handwriting sample in the writer. The behavioral analysis is conducted from your baseline slant, the pen pressure, the slant from the writing and sized letters. The output is often a set of personality trait on the writer. The full technique is depicted in respective figure. Images of handwritten samples are uploaded to the system. The machine requires pre-processing work on the user as a way to begin calculating the scales from horizontal and vertical category. The uploaded image is pre-processed and resized towards the correct orientation. The application form allows users to crop images into lines, words and characters. If the images are cropped, the cropped images is going to be displayed within the scratchpad. From the analysis window, a cropped image will be loaded. According to the specimen chosen data points can be plotted. An individual must plot some data points about the image that identify the superior, middle, base and bottom lines from the handwriting by using a predefined feature of MATLAB name as Corner point extraction but first the scanned image is converted into a grey scale image.

Input Database

The input database includes 12 handwriting samples from 12 different writers. The writers were made to write the given character. The alphabet is a simple character ‘t’ that includes all possible characters of the English alphabet ‘t’.

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Figure 8: Samples of Same handwritten Words

Load Image

The next step in this project is to load the database samples to the GUI so that the user have an idea about the type of 't' that he is going to choose. No doubt he/she can choose the type of 't' that they can made while writing which doesn't match our database 't' sample, as the sample are restricted in number but if 't' other than the sample is chosen than it will no match found message. But to be very frank almost all important type of 't' sample is included in our database. The image is loaded in the GUI after converting it to gray scale and as neural network demands for same size image so the image is converted to the same size before loading.

Select Character and Find Corner Points

The next step is to ask the user to select any character from anywhere if he/she have one or can select from the database sample .After selecting the character (it may be 't' or any character) ,the next step is to find the corner points of that selected character. This step finds all the corners points which will be match by the corners points of the database samples later

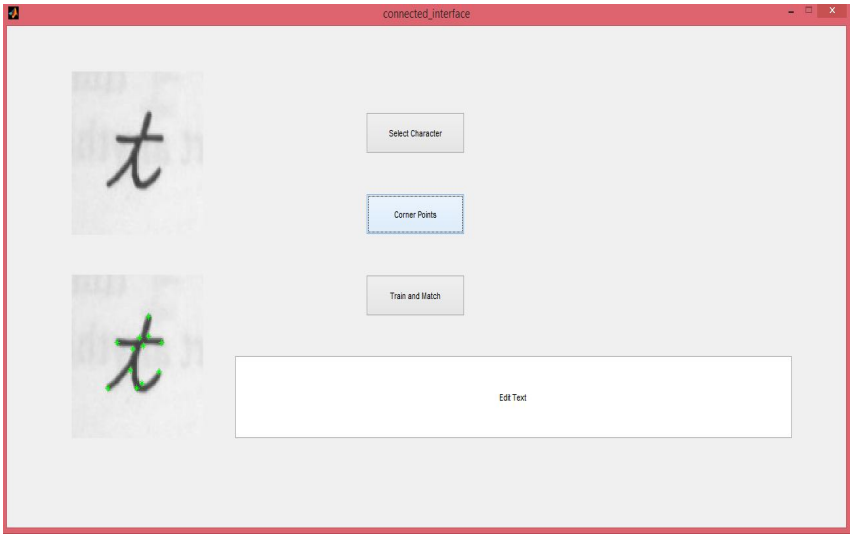

Figure 9: Detecting Corner Points

Train & Match

The next step is to match the selected ‘t’ with our 12 samples, whose corners points were already being calculated by train them with the neural network. And if the same corners points will be calculated than we can say that we have a perfect match and it will show the type of ‘t’ we have with the corresponding characteristics that this ‘t’ has with it in the edit box just below the train and match button in the GUI. The train and match corners points will be shown in the red colour so that both the corners points calculation (before training and matching and after training and matching) may distinguish

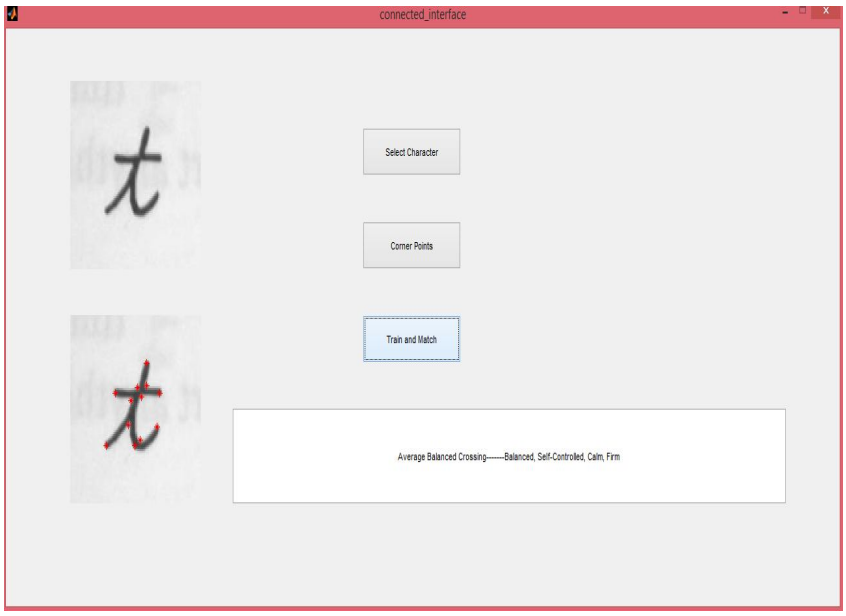

Figure 10: Train Alphabet showing behavior

Algorithm Implemented – for a Sentence

```
Algorithm Implemented – for a Sentence

Setup
Initialize required variables
Read image having handwriting to be analyzed

Begin:
Step1.  grayImage <- rgb2gray(colorImage)          /*converrgb image to gray */
Step2.  mserRegions <- detect MSER Features of grayImage
Step3.  extract regions
Step4.  Convert MSER pixel lists to a binary mask to put on the image
Step5.  Run the edge detector
Step6.  cc  <-bwconncomp(edgeMask)                 /*get connected components */
Step7.  charProperties <-regionprops(cc, 'All') /*get region properties */
Step8.  Find intersection between edges and MSER regions
Step9.  I_gray <-histeq(grayImage,256)             /*equalize image (256 bit) */
Step10. mask is the initial contour state
Step11. Remove small connected components that are less than 100 pixels
Step12. Only keep the object, remove the rest
        I_clean <- I
        bw_rgb(:,:,1)  <- ~bw
        bw_rgb(:,:,2)  <- ~bw
        bw_rgb(:,:,3)  <- ~bw
        I_clean(~bw_rgb)  <- 0
        I_clean <- reshape(I_clean, size(I))
Step13. Find a bounding box for each object
Step14. Get coordinates of bounding box
        coords <- floor(bb(i).BoundingBox )
Step15. Crop image for each object
        cropped{i}  <- I_clean(y1:y2, x1:x2, : );
```

```
Implemented – for a Sentence (Contd...)
/* calculate properties */
Step16. average <- floor((max+min)/i)     /*get average */
Step17. length <-oc /* length of the sentence */
Step18. height <- or /*height of the words */
Step20. no_of_objects <-i /* no of  words */
Step21. word_gap <- ceil((original_length/(average_normal*i)))  /*gap between words */
Step22. slant <- 90 - centroid
Step23. if slant <0 /*slant towards left */
            h(ii)=1
            elseif slant>0 /* right slant */
                h(ii)=2
            elseif slant==0 /* upright */
                h(ii)=3
        endif
Step24. ii=ii+1
Step25.  ifword_gap> 5 /* loose */
            h(ii) = 4
            elseif word_gap < 5  /* tight */
                h(ii) =5
            elseif word_gp == 5  /* normal */
                h(ii)=6
            endif
Step26. ii=ii+1;
Step27. if  height> 230 /*big letters */
            h(ii) = 7
        elseif height <230 /*small letters */
            h(ii)=8
        elseif height ==230
            h(ii)=9
        endif
```

```
Implemented – for a Sentence (Contd...)

Step28. l <-length(h)  /*length of sentence array */
Step29. la <- length(alpha)  /*length of alphabet array */
Step30. fori <- 1 to l
            predict(i)  <- h(i)
        endfor
Step31. for ii <- 1 to la
            predict(i) <- alpha(ii)
            i=i+1;
        endfor
Step32. /* interpretation */

if predict(1) equals to1 and predict(2) equals to 4 and predict(3) equals to 7
and predict(4) equals to 1 and predict(5) equals to 1 and predict(6) equals to 1
and predict(7) equals to 1
    job <- 'computer, electronics'

elseif predict(1) equals to1 and predict(2) equals to 4 and predict(3) equals to 7
and predict(4) equals to 2 and predict(5) equals to 2 and predict(6) equals to 2
and predict(7) equals to 2
    job <-  /*fill from book u have */

elseif predict(1) equals to1 and predict(2) equals to 4 and predict(3) equals to 7
and predict(4) equals to 3 and predict(5) equals to 3 and predict(6) equals to 3
and predict(7) equals to 3
    job <- /*fill from book u have */

elseif predict(1) equals to1 and predict(2) equals to 4 and predict(3) equals to 7
and predict(4) equals to 4 and predict(5) equals to 4 and predict(6) equals to 4
and predict(7) equals to 4
    job <- /*fill from book u have */
```

```
Implemented – for a Sentence (Contd...)
if predict(1) equals to 2 and predict(2) equals to 5 and predict(3) equals to 8
and predict(4) equals to 1 and predict(5) equals to 1 and predict(6) equals to 1
and predict(7) equals to 1
    job <- 'computer, electronics'

elseif predict(1) equals to2 and predict(2) equals to 5 and predict(3) equals to 8
and predict(4) equals to 2 and predict(5) equals to 2 and predict(6) equals to 2
and predict(7) equals to 2
    job <-  /*fill from book u have */

elseif predict(1) equals to2 and predict(2) equals to 5 and predict(3) equals to 8
and predict(4) equals to 3 and predict(5) equals to 3 and predict(6) equals to 3
and predict(7) equals to 3
    job <- /*fill from book u have */

elseif predict(1) equals to2 and predict(2) equals to 5 and predict(3) equals to 8
and predict(4) equals to 4 and predict(5) equals to 4 and predict(6) equals to 4
and predict(7) equals to 4
    job <- /*fill from book u have */

elseif predict(1) equals to 2 and predict(2) equals to 5 and predict(3) equals to 8
and predict(4) equals to 5 and predict(5) equals to 5 and predict(6) equals to 5
and predict(7) equals to 5
    job <- /*fill from book u have */
endif
```

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```
Implemented – for a Sentence (Contd...)
if predict(1) equals to3 and predict(2) equals to 6 and predict(3) equals to 9 and
predict(4) equals to 1 and predict(5) equals to 1 and predict(6) equals to 1
and predict(7) equals to 1
    job <- 'computer, electronics'

elseif predict(1) equals to3 and predict(2) equals to 6 and predict(3) equals to 9
and predict(4) equals to 2 and predict(5) equals to 2 and predict(6) equals to 2
and predict(7) equals to 2
    job <-  /*fill from book u have */

elseif predict(1) equals to3 and predict(2) equals to 6 and predict(3) equals to 9
and predict(4) equals to 3 and predict(5) equals to 3 and predict(6) equals to 3
and predict(7) equals to 3
    job <- /*fill from book u have */

elseif predict(1) equals to3 and predict(2) equals to 6 and predict(3) equals to 9
and predict(4) equals to 4 and predict(5) equals to 4 and predict(6) equals to 4
and predict(7) equals to 4
    job <- /*fill from book u have */

elseif predict(1) equals to3 and predict(2) equals to 6 and predict(3) equals to 9
and predict(4) equals to 5 and predict(5) equals to 5 and predict(6) equals to 5
and predict(7) equals to 5
    job <- /*fill from book u have */
endif

Step33. Repeat the above steps for other words and alphabets
```

Career by number category

1. Right Slant
2. Vertical (or slightly to Right) Slant
3. Small Size
4. Large Size
5. Slow Writing
6. Fast Writing
7. Spacing Between Words and Lines Same Width as Middle Zone Letters
8. Lines Separated and Evenly Spaced
9. Very Narrow Spacing between Letter and Words
10. Very Wide Spacing between Letter and Words
11. Tall Upper Zone
12. Compressed Upper Zone
13. Light Pressure
14. Medium to Heavy Pressure
15. Angular writing

16. Graceful and Rounded Writing
17. Large Capitals
18. Large Capital "I"
19. "a" and "o" (and top portions of "p", "g", and "q") Slightly Open at Top
20. "a" and "o" (and top portions of "p", "g", and "q") Tightly Closed
21. Some Letters Look like Numbers (eg., "g" looks like "8" or "9","o's" are perfect circles)
22. Strong and Long "T" Bars Centered Above Half-Way on Stem
23. Wide and Long Lower Loops
24. Narrow and Long Lower Loops
25. No Loops in Lower Extensions
26. Wide Left Margin and Narrow Right Margin
27. Narrow Left Margin and Wide Right Margin

Analysis of jobs and profession by categories

Accountant	**2,3,8,21**
Actor	1,4,8,14,16,17,18,19
Advertising	1,4,11,14,17,18,19
Agriculture Work	7,26
Artist (Simple, Rhythmic, Script)	8,11,14,16
Assembly-Line Work	12,27
Attorney	1,4,6,8,15,17,20,25
Author (non-fiction)	1,6,11,14,17,18
Author(Fiction)	3,6,14,15,17,18,21
Bank Teller	2,6,9,21
Bartender	1,4,7,12,16,19,24,26
Book keeper	2,3,9,20,21
Budget Director	2,3,9,20,21

Cashier	2,3,20,21
Caterer	1,6,8,17,19,23
Checker (Supermarket)	2,3,20,21
Clergy	1,4,6,7,8,11,16,17,18,19
Clerical Work	3,8,21
Computer programmer	2,3,14,17,20,21,27
Construction work	4,12,23,27
Contractor	3,6,7,8,14,17,18,22
Conservation work	4,7,8,17,18,19,26
Cook	5,23
Court reporter	2,3,6,7,8,16,20,27
Craftsman	4,7,8,17,18,19,26
Dentist	2,3,6,11,14,15,17,18,20,22,25
Designer	3,8,17,18,20
Desk Clerk	1,4,7,8,16,19,25
Detective	4,6,7,8,11,14,17,18,20,22
Diplomat	1,4,6,8,14,16,17,18,20,26
Doctor	2,3,6,11,14,15,17,18,20,22,25
Dramatics (Writing has simple open appearance)	1,4,11,17,18,19,26
Editor	2,3,6,7,9,14,15,22
Engineer	2,3,6,9,14,17,20,21
Entertainer	1,4,6,7,14,16,17,20,26
Executive	2,3,6,8,11,14,17,18,20,21,22,25,26
Food critic	1,8,11,14,15,17,18,19,22,23
Forest ranger	1,4,14,16,26

Heavy equipment operator	2,12,24,27
Hermit	2,10,12,13,20,27
Historian	2,3,6,12,14,20,27
Housewife	1,4,7,13,16,19,23
Interior Decorator	1,2,8,11,17,18,26
Inventor	2,3,7,9,11,14,15,20,22,26
Journalist	1,6,8,,14,17,18,26
Librarian	2,3,7,9,13,15,20,27
Loan Officer	2,6,9,15,20,21,26
Lumberjack	12,24,27
Manager	2,3,6,14,15,17,18,20
Manual Labor	5,12,27
Marathon Runner	12,17,22,24
Mathematician	2,3,6,9,14,17,20,21
Mechanic	2,12,20,24
Musician	8,11,14,16
Nurse	1,7,8,14,16,19
Philosopher	1,4,7,11,13,16,17
Pilot	2,3,6,10,14,17,27
Poet	1,4,7,8,11,14,17,27
Policemen	1,2,4,6,14,15,17,19
Politician	1,4,6,14,15,16,17,18,20,26
Professor	3,6,7,11,14,15
Psychologist	6,7,8,11,14,17,18
Public Servant	1,4,7,8,13

Public Relations	1,4,6,7,8,11,14,17,18,26
Physicist	2,3,6,9,14,17,20,21
Researcher	2,3,6,7,8,11,14,15,20
Real Estate Agent	1,4,7,8,14,1617,19,26
Receptionist	1,4,7,8,13,16,191,26
Sales	1,4,6,10,14,16,17,181,19,26
Sales Engineer(combination of sales & engineer)	
Scientist (see Researcher)	
Secretary	1,2,3,6,7,8,13,16
Sexual Surrogates	12,16,17,18,19,22,24
Sports Player	12,17,22,24
Statistician	2,3,6,9,14,15,17,18,21,22
Student	2,5,8,12,27
Supervisor (see Manager)	
Teacher	1,3,6,7,15,17
Technician (see Engineer)	
Tool Maker	2,3,5,12,20,21,27
Travel Agent	1,2,7,8,16,19,22
Treasurer	2,3,6,9,14,1,7,28,20
Waiter	1,4,7,12,16,19,24,26
Warehouse Worker	2,5,14,21,24,27

Table 1: Analysis of Jobs & Profession by Categories

Results

Sample (Connected)	Length of whole text	Height of whole text	Word Gap	No. of Objects	Actual Objects	Efficiency (in %age)
1	1009	155	4	5	4	80.00
2	2177	195	5	8	5	62.50
3	1337	213	3	4	3	75.00
4	1167	217	4	4	3	75.00
5	1321	157	4	5	5	99.99
6	1989	195	5	7	5	71.42
7	1827	209	4	6	5	83.00
8	1239	247	3	6	3	50.00
9	1477	187	6	9	7	77.77
10	1625	203	6	7	5	71.42

Table 2: Features & Results of Connected Samples

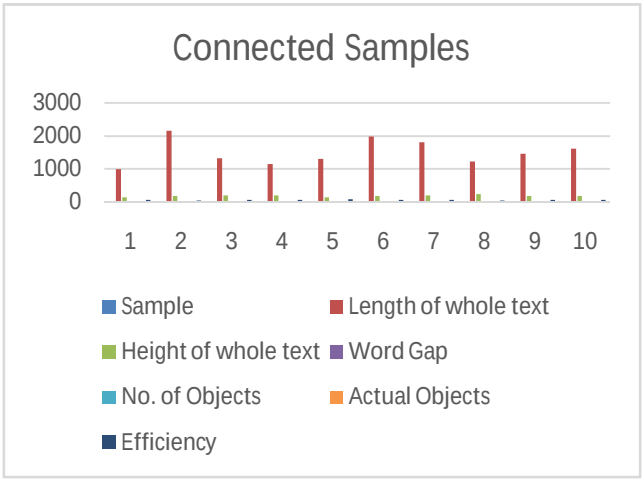

Figure 11: Graphical Representation of Features & Results of Connected Samples

Sample (Unconnected)	Length of whole text	Height of whole text	Word Gap	No. of Objects	Actual Objects	Efficiency (in %age)
1	2213	167	16	12	18	66.66
2	2347	197	13	16	23	69.56
3	2031	173	12	17	21	80.95
4	1793	249	13	11	19	57.89
5	1743	127	15	13	21	61.90
6	2209	179	18	17	23	73.91
7	2295	183	21	18	29	62.06
8	1501	183	13	12	20	60.00
9	1501	183	13	13	25	52.00
10	2079	197	11	11	21	52.38

Table 3: Features & Results of Connected Samples

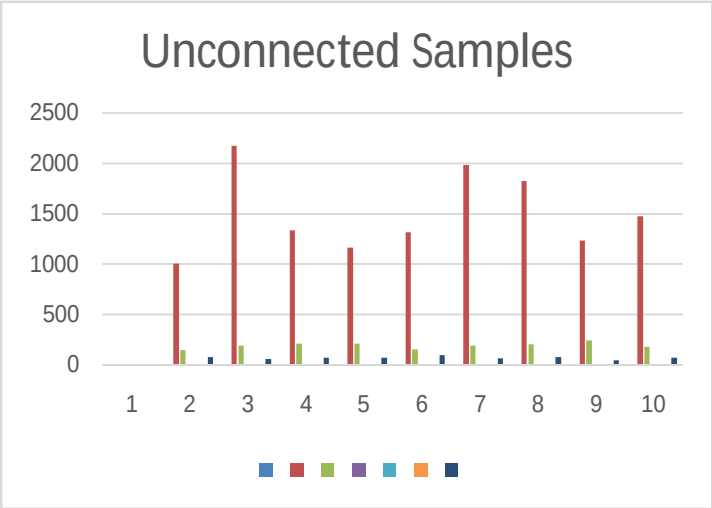

Figure 12: Graphical Representation of Features & Results of Connected Samples

Conclusion

By inputting text as an image from the user which has both connected and unconnected words, then by calculating various features from it like length of the whole text, height of the whole text, word gap, number of objects and actual objects in the text and then we have to extract each character from that text image by performing segmentation for the extraction of character. Then we have to train that segmented character so that we can compare the matching point of the segmented character and the database. The input in our system are both the connect words and unconnected words in the text then by indexing each character, and if the match occur then that index number get initialize. We have made a table of detecting behavior when a proper index set matched with the corresponding row from which we can detect career of an individual later. Someone can also apply our algorithm for check individual career by inputting single character only. But our main focus is on text and not on single character. The good the scanned text, the better is the results. The efficiency of the system is not on the very high side as it depends on the scanned image because it is very difficult to segment highly connected words.

Future work

The ultimate point of the research is to Identify Personality Traits and Especially Traits Resulting in deciding the career of an individual, through Automatic Handwriting Analysis or Graphology. More work can be done on the this Automated System by making it fully functional and allowing the analyzer to automatically auto clean the image if it contain some background issue ,as we want our image (containing text) must be of white background and must be noise free. Extending the program will analyze more samples and find characteristics in an individual's handwriting. Coupled with analysis done in the application, we should be able to determine if there are any characteristics which demonstrate a potential for violence.

We can also take part in extending the system by making an android application so that anyone can download it on their Smartphone for once and can find the career of an individual by making him/her to write a small sentence. And input it with the help of stylus of by clicking the image of that text. The idea of making an android app will plays a major role in determining the personality traits of an individual is also a major challenge which can be done as a future part of the project. From that, we should be able to establish conclusions on whether we feel this is a possible method for personality assessment.

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