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### Human Character Recognition by Handwriting using Fuzzy Logic

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#### Abstract

Handwritten characters recognition is one of the most challenging & burning topic in the field of image processing & pattern recognition. The most prominent problem in handwriting recognition is the vast variation in personal writing styles. There are also a lot of variations within the writing style of person to person. These variations depend on things like the context of the writing, the writing equipment, the writing situation, and the mood of the writer. The writing style may also evolve with time or practice. Thus, the performance of the automatic recognition of handwriting with their behavior heavily depends on how well the different personal writing styles and their variations are modeled with base of fuzzy rules. Moreover this application can be used in image processing & pattern recognition. Proposed system is used to identify human behavior based on the styles of handwriting, digits & signature.

**Keywords:**Fuzzy Logic.

#### Introductions

##### Preamble

Your handwriting develops right from childhood. When you write, your pen is under the control of the muscles of your fingers, hands and arm. All these body parts are under the control of your mind. The manner in which the words are eventually formed by the pen must bear a direct relationship to the mind that guides their formation. Each vibration of movement is unconsciously directed by the brain, so we can judge the mental state of the writer. It is a guide to the will power, intellect and emotions of a person. For an accurate analysis, written text should have been written in a natural manner and the effort should not be deliberate. The best samples are business letters or notes.

Handwriting analysis is a process that has been carried out for centuries. But its effectiveness when analyzing the behavior and personality of an individual is still a debate. Is it possible to detect potential deviant behavior and personality traits of an individual by carrying out an analysis of his/her handwriting? There are two methods of handwriting analysis: Graphology is the method of psychological analysis, and writing samples by a known source, or person.

Even though online handwriting recognition has been researched for over four decades; it is still a tough problem. Due to the recent advances achieved in hardware technology and the emergence and growing popularity of handheld devices, such as

Personal Digital Assistants (PDAs), mobile phones, and Ultra Mobile PCs (UMPCs), new methods for input, besides the keyboard and mouse, such as recognizing speech or handwriting, have been developed. People without prior training can easily learn to use them because of this natural means of communication. This development inspires new applications of handwriting recognition and has led to some novel interests in research.

Handwriting is often referred to as indication of personality trait represented by neurological patterns in the brain. In other words our brain or subconscious mind actually forms the characters as a result of habit. Handwriting analysis also known as Graphology, which is a pseudoscientific study of handwriting in relation to human psychology. Graphology can be used for identifying, evaluating and understanding personality of a person through the strokes and patterns revealed by handwriting. Handwriting reveals the true personality including emotional outlay, fears, honesty, defenses and many other individual personality traits [7].

The present work focuses on development of an automated technique for determining the characteristic traits of a person through image processing called Fuzzy Logic. The proposed work involves image preprocessing of the image as it crops the given sample automatically and uses a RGB filter to extract the text in the handwriting and identifies more than five features in the handwriting simultaneously. The features identified are: size of

the letters, baseline, and pressure of the writing, slant of the handwriting, number of breaks, spacing between the words, margins and speed of the writing in the sample etc. The system is designed to directly indicate the behavior of the person from the above features [8].

The jurisdiction for emphasizing proposed work does the task of graphology which curiously tells the normality function of the human behavior. How matter he writes in which format all depends or checks on this software with our prediction. It is abundant of the graphology that how the person is? And what matter the peculiar with his handwriting we can analyze the person.

### Motivation

The advancement of digital computer, machine simulation of human function has been a very challenging and fascinating research area in the field of image processing and pattern recognition. To recognize behavior using handwriting is not a difficult task for human, but for a computer, it could be very difficult. The problem is how to program a computer to do that kind of task. With conventional approach, it is very difficult to formulate the solution, but the intelligent approach has been developed for this kind of job. The development of Fuzzy Logic system, Artificial Neural Network, Genetic Algorithm, etc. have helped human to program computer to decide something that imitate organism behavior. Fuzzy logic is an important tool to deal with vague, incomplete, noisy and contradictory information. In order to make handwritten communication with machine more natural. The present work focuses on development of an automated technique for determining the characteristic traits of a person through image processing called Fuzzy Logic.

### Problem definition

- Given a set of images which contain human handwriting,
- Predict the behavior of handwriting in each image and pinpoint their locations.
- Tag each handwriting with their behavior that must be stored along with the image.
- Given a set of such tagged images,
- Retrieve behavior based on specified handwriting.

### Objectives

The project has been taken up to satisfy the following objectives:

- To present a system that gives the prediction of human behavior based on his/her normal handwriting.

- To perform the image analysis of handwritings this helps in efficient decision making for human expertise.
- To increase the eligibility of person for particular treat or work.

### Literature survey

In this paper peoples have carried out research of the various state of the art technologies available in analyzing an individual's behavior based on their handwriting and the effectiveness of predicting the character and personality of that individual. They also wanted to determine if we can uncover handedness, authorship and gender through analysis. Apart from working on Lewinson-Zubin method of analyzing handwriting, various online tools are also available for handwriting analysis, such as: NEURO SCRIPT, WANDA, CEDAR-FOX, and Gaussian Mixture Model. Accuracy was 80% [1].

The objective of this research is to develop computer software that can recognize the Thai handwritten characters by using the genetic algorithm technique (THCRGA). The experiment was conducted on more than 10,000 Thai handwritten characters by using 8,160 for training characters and 2,040 for testing characters. The precision of the system is around 88.24%, with recognition speed of 0.42 second per character [2].

In this paper, an improved HMM based recognition model is proposed for online English and Korean handwritten characters. To deal with the problem of handwriting style variations, a modified Hierarchical Clustering approach is introduced to partition different writing styles into several classes. The recognition of handwritten characters is implemented by a modified level building algorithm, which incorporates the Korean character combination rules within the efficient network search procedure and Accuracy was 90% [3].

Character recognition is the mechanical or electronic translation of scanned images of handwritten, typewritten or printed text into machine-encoded text. This paper presents a fuzzy approach to recognize characters. Fuzzy sets and fuzzy logic are used as bases for representation of fuzzy character and for recognition. This paper describes a fuzzy-based algorithm which first segments the character and then using fuzzy system gives the possible characters that match the given input and then using de-fuzzification system finally recognizes the character. Accuracy obtained is 80% [5]

Handwriting analysis is a method to predict personality of an author and to better understand the writer. Allograph and allograph combination analysis is a scientific method of writer identification and

evaluating the behavior. To make this computerized we considered six main different types of features: (i) size of letters, (ii) slant of letters and words, (iii) baseline,

(iv) pen pressure, (v) spacing between letters and (vi) spacing between words in a document to identify the personality of the writer. Segmentation is used to calculate the features from digital handwriting and is trained to SVM which outputs the behavior of the writer. For this experiment

100 different writers were used for different handwriting data samples. The proposed method gives about 94% of accuracy rate with RBF kernel. In this paper an automatic method has been proposed to predict the psychological personality of the writer. [6]

In this paper a method has been proposed to predict the personality of a person from the features extracted from his handwriting using Artificial Neural Networks. Proposed methodology focuses on developing a tool for behavioral analysis which can predict the personality traits automatically with the aid of a computer without the human intervention. In this paper a method has been proposed to predict the personality of a person from the baseline, the pen pressure and the letter “t” as found in an individual’s handwriting. These parameters are the inputs to the Artificial Neural Network which outputs the personality trait of the writer. The performance is measured by examining multiple samples [7].

In the present study a method has been proposed for the behavioral prediction of a person through automated handwriting analysis. The handwriting is analyzed through Image Processing in MATLAB. The developed system identifies handwriting closely which may not be possible for a psychologist. It is real time and involves less image preprocessing. The proposed system is calibrated with manual analysis. The results obtained through the system are in good agreement to more than 80% of the cases with ideal manual analysis [8][6].

Humans are comfortable with pen and papers for authentication and authorization in legal transactions. In this case it is very much essential that a person’s Hand written signature to be identified uniquely. The development of efficient technique is to extract features from Handwritten Signature Image and verify the signature with higher accuracy. This paper presents a method for off line hand written signature verification with higher accuracy. In this paper we have introduced a procedure to extract features from Handwritten Signature Images. That computed feature is used for verification. Here we used a clustering technique for verification. Accuracy 80% for Cluster 2 [9]

In this paper, an online isolated Arabic handwritten character recognition system is introduced. The system can be adapted to achieve the demands of hand-held and digital tablet applications. To achieve this goal, despite of single neural networks, four neural networks are used, one for each cluster of characters. Feed forward back propagation neural networks are used in classification process. This approach is employed as classifiers due to the low computation overhead during training and recall process. The system recognizes on-line isolated Arabic character and achieves an accuracy rate 97% from untrained writers and 99.1% for trained writers. [10]

In the present paper, we have given a method to recognize a handwritten character by using Fuzzy membership function. Ten sample images of each character in matrix form are fused together to make one standard matrix of the character. The unknown character to be tested for identification is also converted to an image matrix and compared with each standard matrix and hereby recognized by using the Fuzzy scores generated. Several binary images have been tested to demonstrate the effectiveness of the system. This method improves the character recognition method of Chakraborty and Sil (2005) in terms of accuracy. [11]

To recognize handwriting digit is not a difficult task for human, but for a computer, it could be very difficult. This project implements the Fuzzy Logic system to recognize the handwriting digit. The design of fuzzy logic will use fuzzy logic editor. The fuzzy system has inputs and 1 output with 57 rules. The average result of recognizing process is 80% after membership functions tuning [12][13].

## Proposed methodology

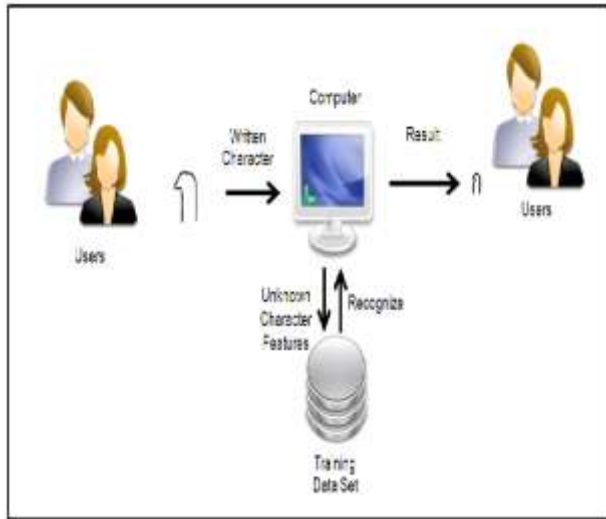
### General Architecture

Professional handwriting examiners called graphologist often identify the writer with a piece of handwriting. Accuracy of handwriting analysis depends on how skilled the analyst is. Although human intervention in handwriting analysis has been effective, it is costly and prone to fatigue. Hence the proposed methodology focuses on developing a tool for behavioural analysis which can predict the personality traits automatically with the aid of a computer without the human intervention.

In this section, we present all details of proposed system design. First, we start with the overall framework of the handwritten character recognition system. Then, we give each component detail. Finally, we present the user interface. First, the system captures the human hand written character images and stores them in a computer system.

Second, the system extracts several features from the character images such as the baseline, size of letters, writing pressure, connecting strokes, spacing between letters, words and lines, starting strokes, end-strokes, wordslant,

Third, the system uses all features of a character to generate the predicted behaviour. Fourth, the system recognizes human behavior with normal handwriting.



General Architecture

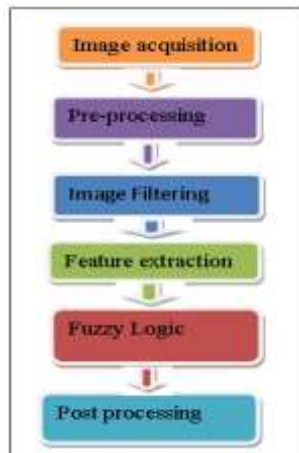
**Proposed Architecture**

Implementation consists of two categories.

- Offline-usually capture by scanner by the optimization.
- Online-two dimensional co-ordinates of successive points are represented as function of time & the order of strokes made by the writer.

**The proposed recognition system**

Typically handwriting recognition system consists of these steps.

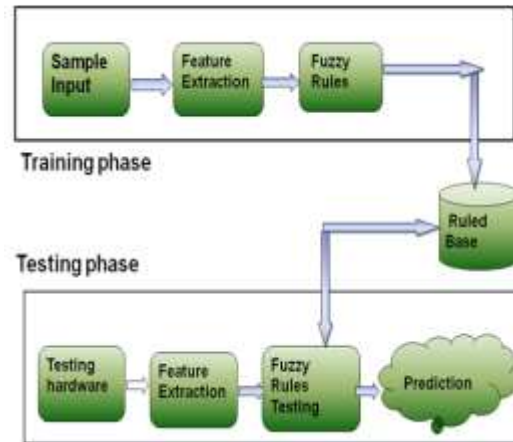


Proposed System Architecture

**Design Architecture**

The structure of the whole system is illustrated in Figure 4.3. The task of recognizing and classifying the characters from an image file, goes through a few processes as illustrated by the figure. First we have to collect sample hand writings that we have to keep in database. Here For every person we have collected hand writing samples for database. It is better if we can collect more hand writing samples for database. Then for verification collect test hand writing against the sample hand writings. These test hand writings we have to verify if it is genuine or forgery.

Each of the hand writings (Samples and corresponding test) has to take within a same sized rectangular area on paper by pen and collect the image of that rectangular area. The written paper is then scanned at 500 dpi resolution by a gray scale scanner. Therefore, the hand writing image will be processed in various stages in order to determine if it is genuine or forgery. Design architecture shows two stages which will be presented in the following subsections.



Block Diagram

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