

Recognition of Handwriting Based on Signature and Digit of Character Using Multiple of Artificial Neural Networks in Personality Identification

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ABSTRACT

Handwriting stroke reflects the written trace of each individual's rhythm and style. By examining all elements of handwriting and interpreting them separately or integrated, we could generate a sketch of the writer's character traits, emotional disposition and social style using standard of graphology. As image, the analysis of graphology is divided into two approaches that graphics features and segmentation digit each character. In this research, using combination of graphical approach based on signature and digit of character of application form using multi-structure algorithms and artificial neural networks (ANN). The image split into two areas: the signature based on nine features and application form of letters digit area. Each area had pre-processing performed to improve the recognition accuracy. Signature area is classified using ANN based on five features which result an accuracy of 56-78%. While four feature of the signature that detection using multi structure algorithm result 87-100% accuracy. In meantime, pattern recognition of application form digit area using Learning Vector Quantization gave 43% accuracy. It used 100 sets of data testing after training with 10-25 data. The system has been implemented with the software so that it can be used for classification of personality from handwriting scanned automatically.

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1. INTRODUCTION

Human personality recognition is becoming more and more important in the modern world. It helps human simplify their jobs and solve more complex problems. Handwriting analysis or Graphology is a scientific method of identifying, evaluating and understanding personality through the strokes and patterns revealed by handwriting. In Graphology, handwriting is analyzed by structural graphic elements in order to derive information about the writer's personality. With the aid of graphology theory, graphologists identify the qualities, traits, attitudes, sentiments or postures that seem indicated in the handwriting; they further seek insight into how these aspects of selfhood may integrate together to constitute the dynamic organization that we recognize as the personality of that writer [1]. There are two approaches in graphology i.e. graphical analysis of the structure type of writing and analysis of the type of symbol or letter. Signature analysis includes first approach. This research has been to integrate the two approaches. Type of writing in the form of signatures and letters stroked can describe the personality of the author. Some types each letter is written [2]. Meanwhile the use of signatures is usually used to identify certain personality as with appearance of dots, streaks, shapes or shell, and bottom line [3],[4].

If the graphology test is still done manually it takes a long time considering the aspects reviewed in graphology very much. Besides, 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. Development in image processing and pattern recognition lead to analyzing of handwriting based on graphology can be done automatically. So it can be used by society at large. Handwriting is included in the

image, so that recognition can be performed through the stages of conversion of images into numerical vector, image processing for quality improvement, followed by feature extraction and pattern recognition.

Several research handwriting analysis automatically with the aid of a computer without the human intervention to predict personality traits have been conducted. Some of them, using baseline, the pen pressure and the height of the T-bar on the stem of the letter 't' are considered for predicting the personality of the writer [5]. Other research about personality analysis considered six main different types of features i.e. size of letters, slant of letters and words, baseline, pen pressure, spacing between letters and spacing between words in a document to identify the personality of the writer. It used SVM that generated various parameters are then calculated by simple use of trigonometry and threshold technique [6]. While other research using the polygon method for pattern recognition based handwriting baseline, slant letter and pen pressure, and the identification of letters i and f using template matching as the input of neural networks [7]. There is also research that uses holistic paradigm in handwriting recognition with whole word approach [8], using back propagation for handwriting analysis in the selection of employees with respect to the size of 'a' letters [9].

This research is a continuation of previous research that only using handwriting based on five features [10]. To further give overview the personality, the type of handwriting analysis conducted on two areas which the author stroked on a sheet of A4 paper. The first area is the application form which consist 32 boxes that is written in capital letters. Each type of handwritten letters is classified using Learning Vector Quantization (LVQ) to get three dominant of personality trait. The second area is the type of signature analysis. From signature pattern, five features identified by ANN and four features using multi-structure algorithm. Each area had pre-processing performed to improve the recognition accuracy. The combination of letter recognition and signature is intended to provide a more complete overview the personality. Each features recognized in parallel that indicates the distinct personality, in order to obtain a review of certain personalities. The success of the system is determined recognition accuracy against graphology test manually.

2. DIGIT OF CHARACTER HANDWRITING AND SIGNATURE FEATURES

Handwriting analysis is divided into two parts, that analysis of digit of character handwriting and signature analysis. Analysis of letters digits are 156 types of 26 capital letters. Each box in the application form recognized as one of the 156 class letters, as shown in Figure 1.

Table 1. Examples of the type of each letter [2]

No	Type	Description	Personality
1		Nearly rectangular	Have skills in the field of mechanical
2		Full cycle and round	Like imagining
3		Full cycle and widespread	Generous
4		Narrow cycle	Shy
5		The top of a separate	Have high aspirations
6		The top like horns	Unruly
7		Like letter X	Depression
8		Center line is under	Dependence
9		Midline above	Has the advantage
10		Open at the top	Much Talk

Meanwhile, signature analysis using nine features to identify certain personality, as in Table II. Piece of paper is a space, and how the individual stroke it with writing indicating how the author faced his world and the emotional honesty. Based on type of letter and nine features of signature, we can predict his personalities of some aspect.

Table 2. Description nine feature of signature [3],[4]

No	Feature	Image	Type	Personality
1	Curved start		Curved backwards	Comfortable going past
			Curved sharply	To formulate a sharp mind
			Curved smoothly	Be careful, friendly, diplomatic
2	End Streak		Increase	Open, foresight, desires ahead, confident
			Down	Lacking spirit, realistic thinking, lack of confidence, easily discouraged.
3	Shell		Shell	Excessive fear, introvert, do not care are approximately, not sociable and do not like to work together
4	middle streaks		Middle streaks	Possessive
5	Underline		Underline	Have unique ideas and thinking, need support to make decisions, and have reliability in the lead.
6	Extreme margin		Tends to right side	Careless, inattentive
			Tends to left side	Fear of failure, fear of others, lack of confidence, pessimistic
			Tends to top side	Respect yourself, reflect personal happy
			Tends to bottom side	Depressed, shy, feel foreign
7	Dot structure		Dot	Establishment of stable, has a suspicion, not always easy to keep believing
8	Separate		Separate	Had a less pleasant experience in the past
9	Streaks disconnected		Streaks disconnected	Limiting desires, not taking any risks, often discouraged and hesitated to take decisions.

3. PROPOSED METHODS

Human personality recognition based on digit of handwriting and signature analysis of image, as depict in Figure 1.

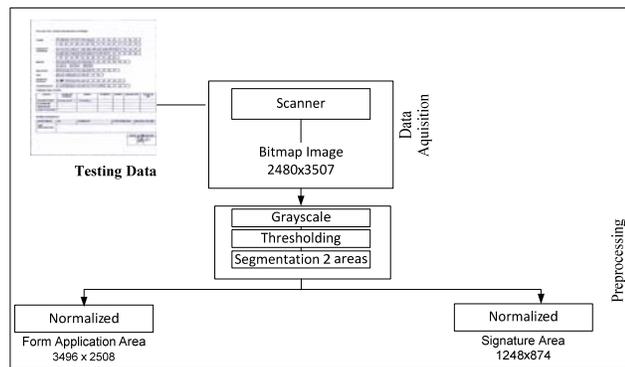


Figure 1. Design of handwriting area and signature area of image of testing data

Classification of digit handwriting depict in Fig 2. Identify the type of letter that is written is divided into three phases, i.e. pre-processing stage, each letter recognition stage and the third that decision-making stage to determine three dominant personality type. Pre-processing stage of each letter generated vector of 32 boxes of filled application form. Then, stages of each letter pattern recognition using LVQ with the network shown in Fig 3. It has been after training using the training data in 1560 with 156 selected classes.

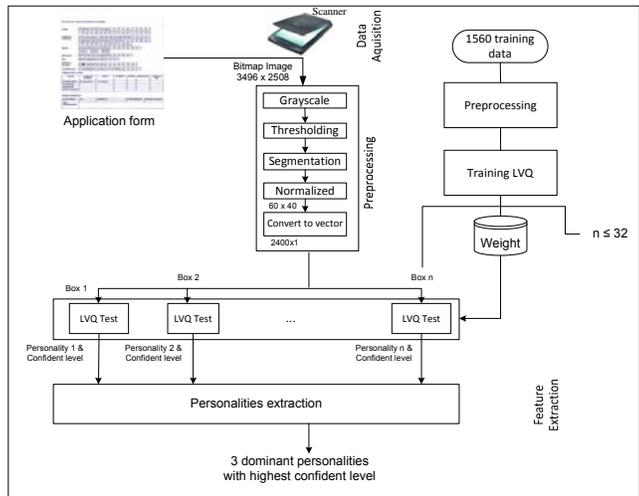


Figure 2. Pattern recognition system based on digit of handwriting of application form using LVQ and feature extraction

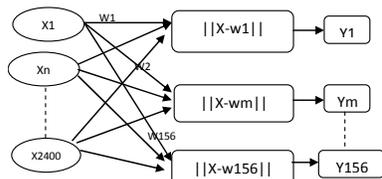


Figure 3. Architecture of pattern recognition of letter using LVQ

Recognition system using LVQ that carried by computing the nearest distance each class of 156 classes. Each test had different value of nearest distance compare with others. The higher the difference is referred to its proximity to the higher level of confidence. This gives an idea in determining the dominant personality of a number of personality obtained from each type of letter every box. Stage determination of the dominant personalities contained in the third stage, i.e. by computing three personalities that have the highest level of confidence. Recognition of signature area based on the nine features, i.e five features using ANN and four features multi-algorithm structure, as shown in Fig 4. Area signatures are processed starting from the signature area. Signature identification based on four was done by computing black pixels in signature matrix. Identification extreme margin features by comparing the distance between left and right margin, between top and bottom margin. Detection of dot structure by assuming the dot is a separate structure with a size of 5-17 and 5-15 pixels tall. Detection separate signature was done by finding from top to bottom white pixels more than 15 series. Streak disconnected structure detection was done with the assumption that are on the right, a length of 20 to 38 pixels and a width of 5 to 15 pixels. The detection are same with dot detection.

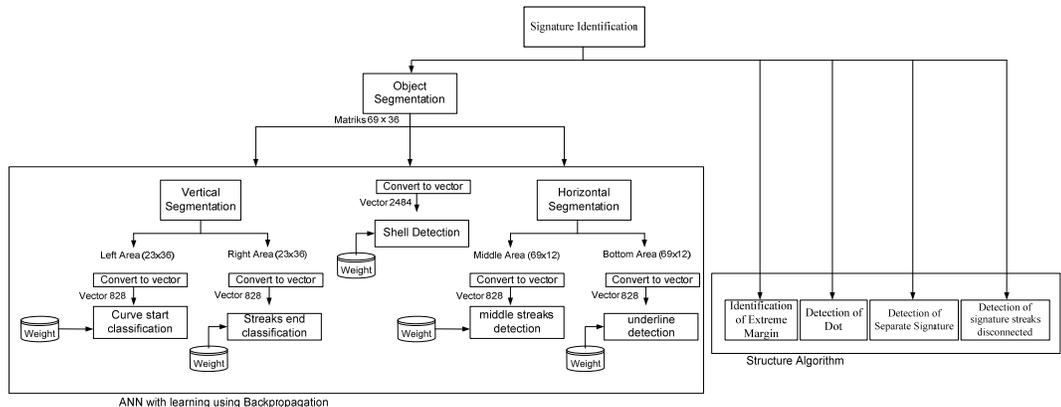


Figure 4. Recognition of signature system consist 5 features using ANN and 4 features using multi structure algorithm

Meanwhile, identification based on five features using ANN after object segmentation as Fig. 5.

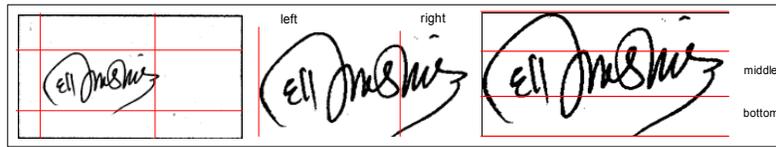


Figure 5. Segmentation process of signature area

Fit area of signature as Fig. 5, vertically divided into three parts, the left side is used for the identification of curve start and the right part is used to identify the type of end streaks end, declining or ascending. Then the fit area of signature horizontally divided into three parts, the center is used for detection streaks middle and bottom are used for detection of the end of the under line signatures. Then was developed identification each feature using MLP, so has obtained five networks. It consists of input layer with 828 neurons (except for shell, 2484), hidden layer with 10 neurons and the output layer with two neurons (except, three for curved start), which are connected via weights. The weights are obtained from the training which is a generalization training data using backpropagation algorithm. It is shown in Fig 6.

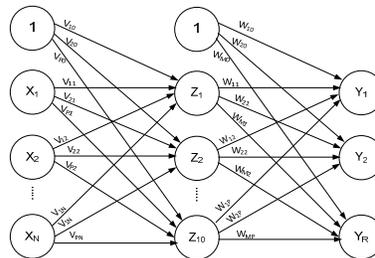


Figure 6. Architecture MLP for signature identification

Tests performed on 100 testing data from handwritten image size 2480 x 3407, which carried out preprocessing, training and testing as shown in Fig 1. Each feature is tested through the process of segmentation so that its different data sizes. Meanwhile, for testing against baseline features done after the ANN trained with 25 sets data for each type each features for signature identification and 10 set data for type of letter identification. Training conducted on each of its features.

4. RESULT

Tests carried out on a sheet of A4 paper which is divided into two areas including the type of letter and signature area. So testing is done separately. Training is also conducted each feature. Of 26 letters, each of which has 6 types, in order to obtain 156 classes. The number of classes that were required a relatively fast method such as LVQ in training. While the analysis of the signature area provides 15 types of 9 features have vary widely so it takes relatively more rigorous methods, such back propagation.

Output of the system compared to the identification type of handwriting by expert. Of the 100 test data, testing of each letter recognition system as a whole or a maximum of 32 letters in the application form only provides accuracy of 43%. However, if the terms of each letter, obtained recognition accuracy of 56%. It because, at the time of training which included training data was never recognized so that when the testing process this type will never be right in the testing process. Recognition of training data gave 77% accuracy.

Recognized signature area that the test data of 100 signatures, 100% accurately detect the extreme margin, dot structure and separate signature. And 87% accurate for the detection of streaks disconnected. The four features were tested using structural identification methods graphics. Meanwhile, tests on five features using ANN obtained 63% accurate for the beginning of the curve, 58% accurate for the detection of streaks end, 75% accurate for middle streaks, 70% accurate for the detection of the bottom line and the 56% detection of the shell. The use of five ANN designed in parallel and called multiple ANN allows detecting the presence of more than one feature. Weakness of using ANN to recognize baseline feature is less variation of the data training and the number of neurons in the hidden layer is only 10. The magnitude of the size of the image does not affect the accuracy of pattern recognition significantly, but the effect increase number of memory and processing time to be recognizable that will produce a personality.

This research gave that using LVQ to recognition less accuracy, only 43%. It was compared to signature recognition using MLP which reaches 56-75%. But of the 156 classes, training time with LVQ only takes 32 hours, relatively realistic than 6 hours of training to use the MLP to recognize only 3 classes.

5. CONCLUSION

Handwriting identification system that was developed as part of a research to identify the type of handwriting from a variety of features in order to obtain an overall picture of the personality that can be used for employee selection one of them. This research that proposed recognition of handwriting with combining identification of signature style and digit of character or letter using multiple network can predict more aspect of personality reviewed. This system has been implemented in software to provide convenience to the public in identifying personality easily and quickly. It can be used in the selection of the employee or job from his handwriting. For future, analysis can be improved by more features and improve pre processing.

For the introduction of the use of LVQ type font that is so good it can be continued on following the research to using other algorithms including back propagation. Variation of training data and number of hidden neuron in MLP affects the success of the recognition, while the image size is less influential.

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