

# Signature Recognition with Dominant Point Method

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## Abstract

*One method to show someone's identification is by using signature. By giving his signature, people can get authorization for doing something like entering secret room or crediting his account. But there is a possibility for others to fake this signature. So we need a system that can recognize a signature.*

*This research aims to develop a signature recognition system by using dominant point method. With Dominant Point, a signature will be recognized depend on the moving direction when writing the signature. There is assumption that everybody has a special movement when writing a signature.*

*Dominant Point method will choose some points to be curve's local extreme of the signature. The points are called as dominant points. Depend on the points are found, this method will determine the stroke direction. And then the alternation of the stroke direction will be converted into a number. In the final system this number will be matched with the reference that had been made on the beginning of the testing. In this experiment this system could detect successfully for about 96%.*

**Keywords:** hand stroke recognition, dominant point, curve critical point, moving direction

## 1. Introduction

First of all, we need an identifier to identify someone such as ID, picture, or signature. Signature is used to authorize some jobs like withdraw money, payment with credit card, and validate document. But, more people use signature will cause more crimes related with signature happened. So a recognition system is needed to detect the possession of a signature.

This research will result a system that can recognize signature by using dominant point method [4]. The most important thing is the direction of hand scratch when making signature. Because there is assumption that everybody has a special movement when writing a signature. This cause that if other give a fake signature, the moving direction may be different.

There are two category for recognize signature in general: online and offline. Online mean that recognition is done when people write his signature. On the other hand, recognition is done after people write his signature. Dominant point method using in this research will detect online. So an input device is needed to give a signature like mouse or pen mouse. The system will read the input when user clicks the mouse. The result is a curve that consisting of many points. Then the process will choose some points to be critical point of the curve and it will called dominant point. Depends on the dominant point, this system will define the stroke moving direction and it will be matched with the reference to get the result of the recognition.

## 2. Dominant Point

Dominant points are points that one of the next type: (a) start point and final point of a stroke; (b)

local extreme; (c) middle point that connected the previous two points in (a) and (b) [4]. If there is a function  $f(x)$  and  $f'(x_1) = 0$ , where  $x_1$  is a number including in domain of  $f$ , so  $x_1$  will caused the value of the function maximum or minimum. And  $T(x_1, f(x_1))$  is called as critical point of the function  $f(x)$  [1].

Local extreme includes local maximum and local minimum. Local means that the point is extreme for some interval in the domain function [6].

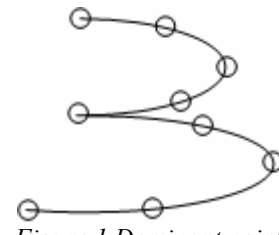


Figure 1 Dominant points

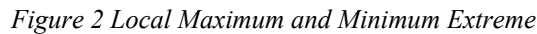
### 2.1 Local Maxima and Local Minima

To determine whether an extreme point is local maximum or local minimum or the others, we need to focus on the changing of derivative sign. If the sign changes from plus to minus or minus to plus, the point must be local maximum or local minimum. On the other hand, the point is not local maximum and not local minimum.

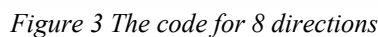
(a)  $(x_1, f(x_1))$  is local maximum if  $f'(x_1) > 0$  for  $x < x_1$  and  $f'(x_1) < 0$  for  $x > x_1$ .

(b)  $(x_1, f(x_1))$  is local minimum if  $f'(x_1) < 0$  for  $x < x_1$  and  $f'(x_1) > 0$  for  $x > x_1$ .

Therefore it can be said that a point is called local maximum if in that point the function change from increasing to decreasing and local minimum if the function change from decreasing to increasing. Local maximum and minimum will have extreme value just in some intervals of domain function. The other way, the value of global maximum will be the largest for all domain function and the value of global minimum will be the smallest value for all domain function.

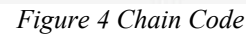


Direction primitives use to convert moving direction into codes. There are 8 kinds of moving direction, that are E, SE, S, SW, W, NW, N, NE. The direction will code into number 0-7. After doing the coding, chain code will be obtained for every stroke.



*Table 1 The determination of direction code depend on  $\Delta x$  and  $\Delta y$*

$d_i$	0	1	2	3	4	5	6	7
$\Delta x$	1	1	0	-1	-1	-1	0	1
$\Delta y$	0	1	1	1	0	-1	-1	-1



The flowchart that shows in Figure 5 is used to illustrate the working process of the system entirely.



The system that has been developed consists of two kind processes: **GetData** and **Recognize**. The **GetData** Process is used to record the data reference, meanwhile **Recognize** Process is used to recognize signature. There is a same step for the all process that is input, data preprocessing and feature extraction. The main different is **GetData** Process records the data reference to the database but **Recognize** Process passes the character classification step that will

compare with the data reference in the database to find the owner of the signature.

Before entering data preprocessing step, normalization process is done to change the size of the signature become a standard size. After that, the software will record the start and final area of every stroke. And then the coding process of the moving direction will be done through the direction primitives process. The result of that process is the chain code of every stroke that will use to determine the dominant point in the future steps.

After data preprocessing step, the next step is feature extraction. In this step, the chain code that has been obtained will use to determine dominant points. Then the system does the coding of the dominant point's alteration to yield dominant points chain codes.

To record the data, the result of the feature extraction will be saved to the database. The next step is character classification. This step will compare the chain code that has been got from the previous step with the chain code that has been saved on database. And then a score that shows the similarity of the two chain codes will be produced. The system will choose the biggest score as the result recognition but that score must be bigger than threshold value that has been defined by user. Because the system needs to band the score so the recognition result can be said as a valid result.

#### 4. Implementation and Testing Result

The Implementation is made by using software Delphi 7.0. And the interface of the recognition software can be seen in theFigure 6.

Figure 6 Interface System

The form above gives a blank space for entering the signature. The user can use mouse or pen mouse to input the system. There is also the result of the comparison between chain code saved in database and the new chain code

To test the system, writer had done an experiment that involved 20 users. Each of them tries the software 10 times and the result can be seen in table 1. The example of using this software can be found in Figure 7 and Figure 8.

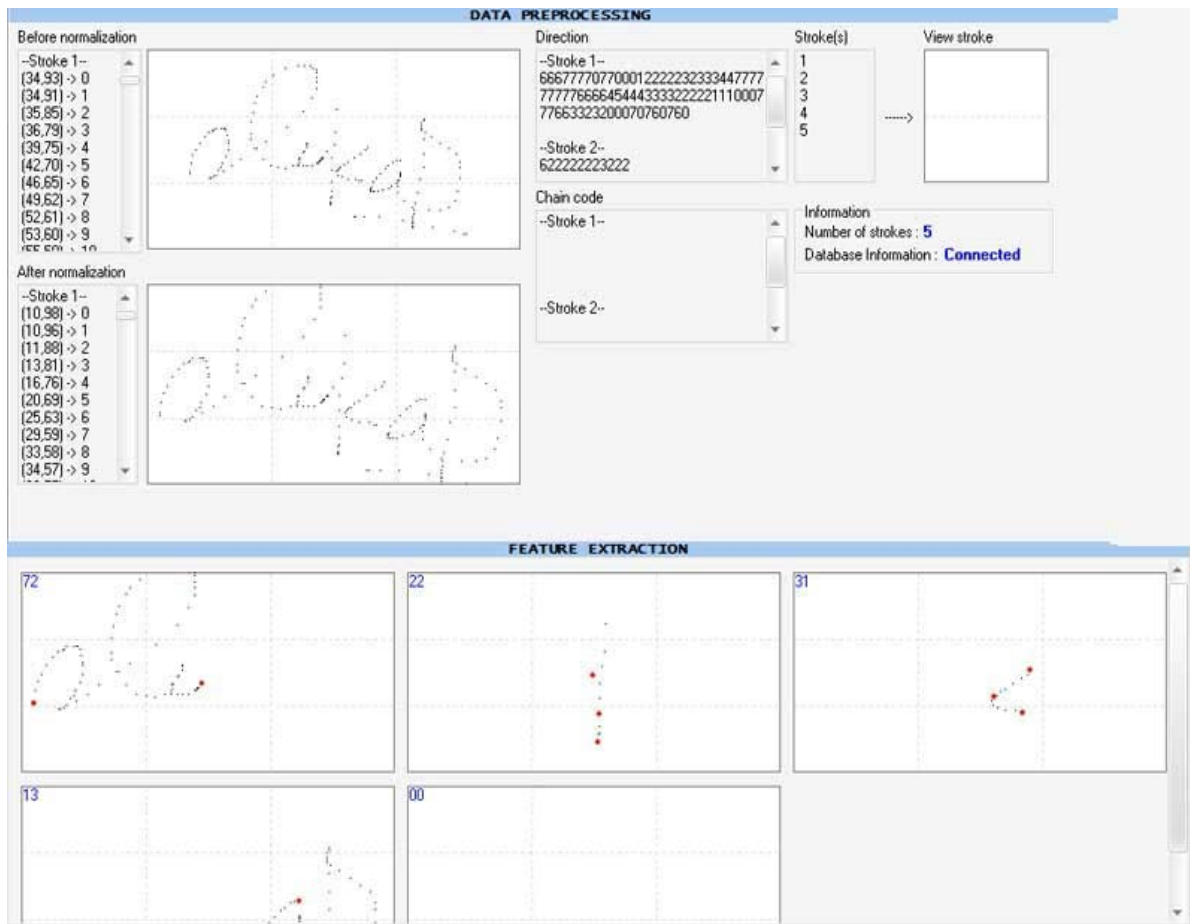


Figure 7 Data Preprocessing and Feature Extraction

**CHARACTER CLASSIFICATION**

**Preclassification (candidate selection)**

Character's code: 72.22.31.13.00

Candidate character(s): 7      Candidate tolerance: 81

Character	Code	Score
Lukas	6723762177220621.22.30.4300592	
Dyna	225607543300.617622.6261.76382	
Astrid	7733702247.6622.55726603072284	

**Fine selection**

Recognition result: **Lukas**

Score:

Character	Code	Score
Lukas	6723762177220621.22.30.4300575	
Dyna	225607543300.617622.6261.76359	
Astrid	7733772207413477.22.7722672359	
Dyna	225607544300.07217722.72661058	
Astrid	7733702247.6622.55726603072250	

Figure 8 Character Classifications and the Result

Table 2 Testing Result

No.	Name	1	2	3	4	5	6	7	8	9	10	AVG (%)
1	Lukas	1	1	1	1	1	1	1	1	1	1	100,0
2	Dessy	0	1	1	1	1	1	1	1	1	1	90,0
3	Christian	1	1	1	1	1	1	1	1	1	1	100,0
4	Okta	1	1	1	1	1	1	1	1	0	1	90,0
5	Mon	1	1	1	1	1	1	1	1	1	1	100,0
6	Ronal	1	1	1	1	1	1	1	1	1	1	100,0
7	Elkana	1	1	1	1	1	1	1	1	1	1	100,0
8	Krisna	1	1	1	1	1	1	1	1	1	1	100,0
9	Bagus	1	1	1	1	1	1	1	1	1	1	100,0
10	Robin	1	1	1	1	1	1	1	1	1	1	100,0
11	Mandee	1	1	1	0	0	1	1	0	1	1	70,0
12	Christina	1	1	1	0	1	1	1	1	1	1	90,0
13	Maya	1	1	1	1	1	1	1	1	1	1	100,0
14	Wijaya	1	1	1	1	1	1	1	1	1	1	100,0
15	Dyna	1	1	1	1	1	1	1	1	1	1	100,0
16	Paula	1	1	1	1	1	1	1	1	1	1	100,0
17	Astrid	1	1	1	1	1	1	1	1	1	0	90,0
18	Lucy	1	1	1	1	1	1	1	1	1	1	100,0
19	Kellyn	1	1	0	1	1	1	1	1	1	1	90,0
20	Ina	1	1	1	1	1	1	1	1	1	1	100,0

Note: '1' means that the software recognize successfully  
'0' means that the software recognize unsuccessfully

## 5. Conclusion

According to the implementation and testing result it can be concluded that:

- The average result of the signature recognition is 96 % with the number of user is 20 people and everyone tries the software for 20 times.
- The system that has been developed always gives the recognition result whether right or wrong output. Therefore the threshold value is used to decrease the unsuccessful recognition. The software will choose the highest threshold value to be the recognition result.
- This recognition system has a weakness that is if someone knows the other's moving direction when writing signature then he can fake the signature.

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