Journal of Multimedia Information System VOL. 4, NO. 1, March 2017(pp.39-42): ISSN 2383-7632(Online)
http://dx.doi.org/10.9717/JMIS.2017.4.1.39

Online Digit Recognition using Start and End Point

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Abstract

Communication between human and machine is having been researched from last few decades and still it's a challenging task because human behavior is unpredictable. When it comes on handwritten digits almost each human has their own writing style. Handwritten digit recognition plays an important role, especially in the courtesy amounts on bank checks, postal code on mail address etc. In our study, we proposed an efficient feature extraction system for recognizing single digit number drawn by mouse or by a finger on a screen. Our proposed method combines basic image processing and reading the strokes of a line drawn. It is very simple and easy to implement in various platform as compare to the system which required high system configuration. This system has been designed, implemented, and tested successfully.

Key Words: Digit Recognition, Handwritten Digits, Feature Extraction, Mouse Stroke

I. INTRODUCTION

Gesture recognition is one of the most important research areas in the field of motion-based image processing and recognition. Recently keyboards are being replaced by handwriting technology on various screen touch devices.

Previous work done on simple digit recognition is using either back-Propagation Network [1] with minimal processing of data, or neural network for recognizing digits [2] where huge data sets are trained and then it is used for recognizing the digits.

Gesture technology is going to be the next evolutionary technology in the world. Since touch screen technology has dominated all other traditional drawing devices, it is very important to analyze the input stroke by finger. Gesture base communication with system has different ways to pass messages to the system.

A common approach to solve a visual pattern recognition problem such as digit recognition is to divide the solution into parts such as feature extraction and classification. This type of approach generally takes time during classification and need high system configuration.

In this study, we designed and implemented a user-friendly system for recognizing single digit drawn by mouse. It has been developed using processing platform which is an open source language built for electronic arts, visual design etc. is simple and can be implemented in any environment especially light weighted computer or any such devices

II. PROPOSED METHOD

Recognizing patterns can be done using many techniques. One of the most popular one is Hopfield neural network. [3][4]

Here we have studied the common writing pattern of digit in Korea after that we came out with a simple algorithm.

First, we have checked the number of stroke is used to write for 0-9. Generally, people of Korea uses two stroke to write 4, 5, 7 and 0,1,2,3,6,8,9 in one stroke.

Secondly, we checked the co-ordinates of the starting and end of the stroke.

Manuscript received April 09, 2017; Revised April 10, 2017; Accepted April 10, 2017. (ID No. JMIS-2017-0010)
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Thirdly, Minimum Bounding Rectangle (MBR) of the digit.

Finally, normalization of size and area of the stroke.

2.1- One Stroke Digits

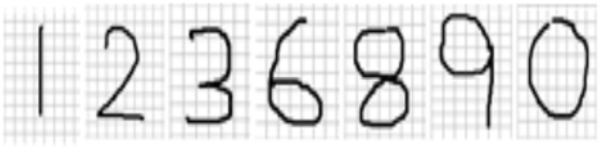
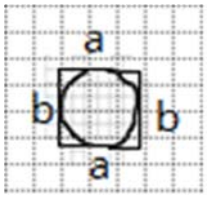


Fig. 1. Single stroke digits.

Number 1 is always drawn as straight line. In the case of "0" and "8", the end point of the stroke is always nearby the start point of the stroke or at the same point. The main difference is that when the length of MBR (Minimum Bounding Rectangle) is greater than length of the stroke, than it is being predicted to be "0"or "8



$$MBR = 2a + 2b$$

Fig. 2. MBR calculation.

In the case of digit "2"the stroke starts from near or on the top-left side of MBR. Digit "3"is predicted when the stroke starts from the left-upper portion of the MBR and ends at the left bottom portion of the MBR. Digit "6" is predicted when the stroke starts from the right upper portion of the MBR and ends at lower left area of MBR. Finally, digit "9" is predicted when stroke starts from upper right and ends at bottom of the MBR.

2.2- Two Stroke Digits

2.2.1 Number '4'

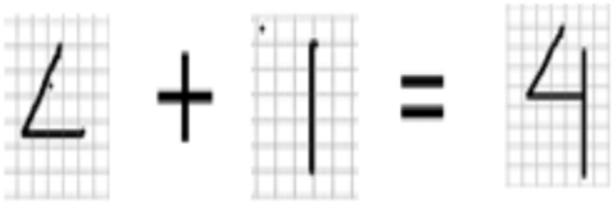


Fig. 3. Digit 4 writing style

For digit "4" the second stroke is usually drawn straight from up to down. The length of first stroke is usually greater than the length of second stroke.

2.2.2 Number '5'

Fig. 4. Digit 5 writing style

Here first stroke is generally drawn in horizontal order and the second stroke starts at left and ends at same axis or nearby axis. Second stroke is always greater than first stroke.

2.2.3 Number '7'

Fig. 5. Digit 7 writing style

While drawing number 7, the first stroke is drawn as an small vertical line and the second stroke size is greater than first stroke.

2.3 RESULT AND DISCUSSION

The tested data representing single digits 0-9 collected from different user writing style. The testing accuracy was found out to be 80% in average of 100 per sample of digits. We have digits "0", "8", "1" with the best accuracy result by 100%. The time needed to recognize each digit was between 0.02 sec. Figure 6, represents the set of outputs of our system.

The implemented system has better performance in comparison with the Mouse Gesture Hindi Digit MGHD [5]. MGHD system used (FCC) with eight connectivity with a template to recognize the Hindi digits.

Figure 6 depicts the result of proposed system based on the tracking of mouse motions called mouse gestures, digits are written with mouse with different style. It is being tested by different person and their writing styles. This system gives 100% result for "1", "0" and "8" to every person who has tested this system. In this system "7" has maximum error rate because the writing style of 7 is different in other countries. We have developed this algorithm according to Korean people writing style.

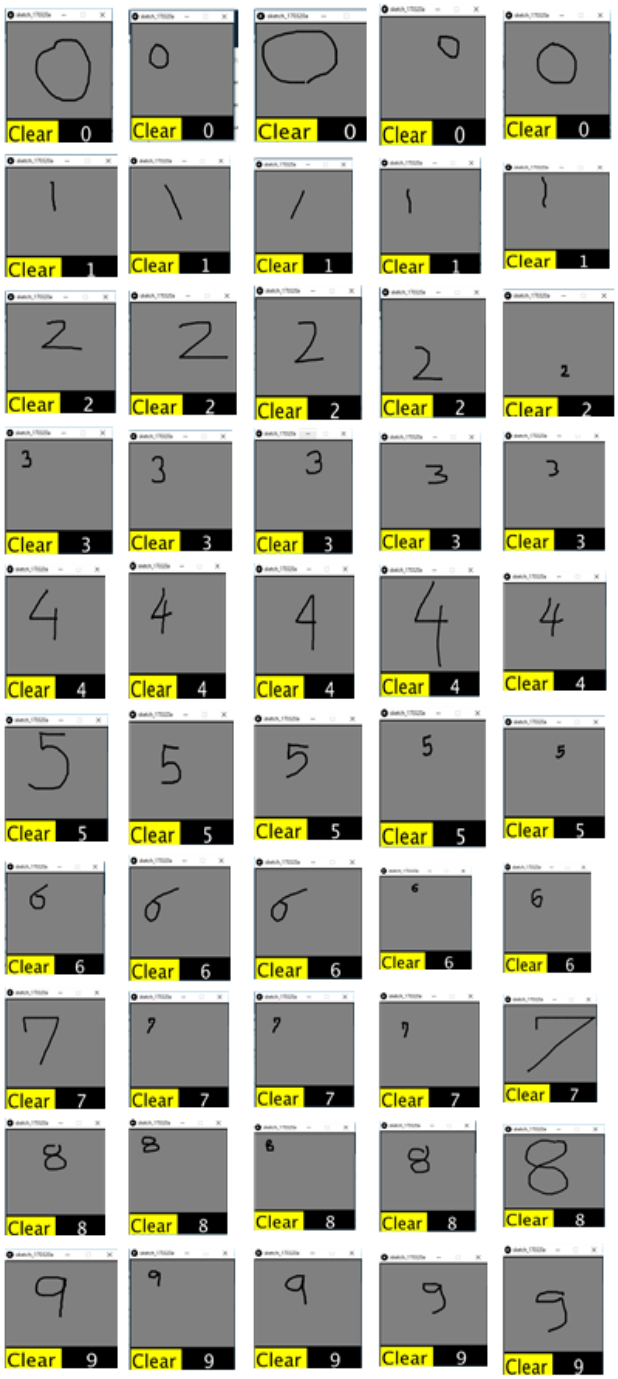


Figure 6: Result of proposed system

III. CONCLUSION

A mouse gesture is a continuous, directed sequence of the mouse cursor movements with the clearly distinguished start and end. In this study, a handwritten recognition system has been implemented to detect single digit drawn by mouse. It is developed by checking the writing pattern with the MBR of the digits. It was being tested by different people writing style. The writing input tool was mouse. This system does need any sample images to train which limits the requirements of hardware for training. Our system can be implemented in any platform with basic configuration.

To further improve the recognition accuracy, possible work is to make the system to detect digits of different writing style. Furthermore, we like to improve the system where more than one digits can be written and detected.

Acknowledgement

Our deepest gratitude and warmest affection go to advisor Prof. Shim Jaechang, for his generous advice, inspiring guidance, encouragement, and professional assistance.

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