

Lazy Recognition as a Principle of Pen Interfaces

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ABSTRACT

The pen is suitable for creative work since one can express almost everything and is not bothered by the method to use. Experimental pen-based systems and products have not exploited the 'automated' nature of handwriting. They try to recognize handwriting immediately after each pattern is written with the result of frequent misrecognition and thus interrupt user's thinking. This paper presents lazy recognition scheme which delays the display of recognition until needed. One's thought is better developed by working with one's handwriting. Lazy recognition also provide easier structure to process handwritten patterns. Automatic segmentation of characters and diagrams is described.

KEYWORDS: pen interface, writers creative workbench, on-line recognition, lazy recognition, pattern segmentation.

INTRODUCTION

Although such merits of pen interfaces are attracting attention as direct manipulation, writing and drawing capability rather than pointing, scalability and mobility, these are not the only merits that the pen brings. Among others, as the writing (drawing) process can be done subconsciously, this helps promote creativity.

Since perfect pattern recognition is nearly impossible, there is a need to rethink the interface cycle of recognition, display, correction and re-input. In the traditional interfaces, immediate recognition of the input is sought. However, there is an interruption to the thinking process owing to the checking of the recognition result and the correction of any incorrect recognition.

Moreover, in most of pen-based systems one is able to preserve just one's handwriting patterns, but unable to then pass them onto the recognition engine. Even if one already has the data right in front of oneself, it has to be re-entered. Without recognition, utilization of the pattern is limited.

Also, in the recognition mode, once the recognition result is displayed one can no longer see the original pattern. One has to re-enter misrecognized patterns without any reference to why they were misrecognized in the first place.

When an emphasis is laid on the human factor for creative work, however, immediate feedback is not required or even

bothering. Coarse or lazy interaction may be more effective than fine or busy interaction. Abandonment of the latter may also provide larger advantage for computer processing. User's actions can be interpreted in broader context.

To apply computer processing to freely written patterns, the segmentation of characters and diagrams is prerequisite. Numerous attempts have been made on this problem in off-line researches, but none in on-line. This is probably because the need has not been recognized. According to the common sense of on-line interfaces, mode selection is easily employed to input characters and diagrams without confusion. But, this is not taking creative interaction into account.

WHY CREATIVE WITH PEN AND PAPER

In creative document preparation the roles of writer and typist cannot be separated. Observation on the actual styles of document preparation was made. Only a small number of people depend entirely on computers. The majority work on paper or printout with a pen at the creative stages to prepare contents, to structure, to brush up, to restructure and so on.

As seen from the viewpoint of 'attention'

According to what cognitive psychology teaches, even when humans just perceive (whether hearing or seeing) stimulus, 'attention' is necessary[1]. The psychological details of the creative writing are still not clear. However, it is a much higher-level of intellectual work than perception. Therefore, a writer must maintain even more attention to that content.

Generally, if 'attention' is simply divided amongst two actions, not only do their quality and efficiency fall, but the mental burden also increases.

'Automated' work

On the one hand, there is work that requires no attention what so ever. Highly dexterous work is like this and is called 'automatic' work. A good example of this can be seen in some English typists. They can simultaneously type and have a completely unrelated conversation.

Nevertheless, for work to be made 'automatic' there is a need to spend an excessively large amount of time on training. If it is only the input of characters this may be achieved without paying attention through the automation of keyboard

input, but it is extremely difficult to automate the use of software for creating diagrams or layout.

Why can we think with pen and paper

The work of handwriting is excessively trained in everyday life, and thus 'automated'. Therefore, 'attention' can always be given to the contents when doing work using pen and paper. Consequently, there is no interruption to the train of thought. This is why we employ pen and paper at creative stages.

LAZY RECOGNITION FOR CREATIVE INPUT

In lazy recognition, the recognition process, or display of the recognition result is not done straight after each individual pattern has been written. The recognition is delayed or is run in the background or in a separate window. In any case, the important point is not to make the user conscious of the recognition during the creative phase. At the point in time when the user decides 'this is one section', in other words when the thinking process has naturally run dry, the confirmation and correction of the recognition result can be done. By this, we remove the obstruction to the thought process. In handwritten input even the pre-recognition pattern can be easily read. Considering the disruption to the thought process that is caused by continual replacement of handwritten patterns by fonts, working with the handwritten pattern has better continuity, even if it is poorly written.

After creative writing, the user works on the result of recognition. At this phase, only the task of confirmation and correction need be concentrated on. The above two processes have been separated so that the both sides can be concentrated on.

For the system, allowing the user to concentrate solely on the correction work makes it possible to draw out from the user accurate instructions for teaching the recognition process without any feeling of awkwardness.

PROTOTYPING

We have prototyped a creative writing environment for text where only the recognition of characters has been included, i.e., diagrams and equations can be inputted as patterns but left unrecognized. In this prototype, we have taken manuscript paper, usually used in the creation of manuscripts in Japanese, as a model for the writing/display format. Fig. 1 shows text insertion on this handwriting based text editor.

CHARACTER AND DIAGRAM SEGMENTATION

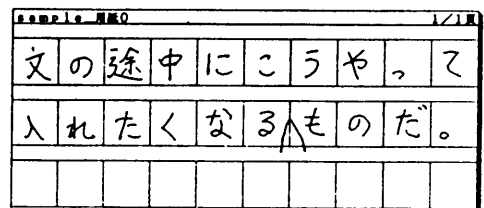
Character pattern and diagram pattern segmentation has been studied for on-line patterns. A graph of the log of character strokes lengths shows that they are normally distributed. On the other hand, the length of strokes that make up diagrams and tables plot evenly in a wide range. This nature, the fact that character strokes often cross one another, as well as that character strokes written wedged (in terms of time) in between

two diagram strokes are unusual, have been used to perform the segmentation. It is not our aim to present the details of this process. The results, applying this to cases where characters are many or few, show that the segmentation is 95% correct. An example is shown in fig. 2.

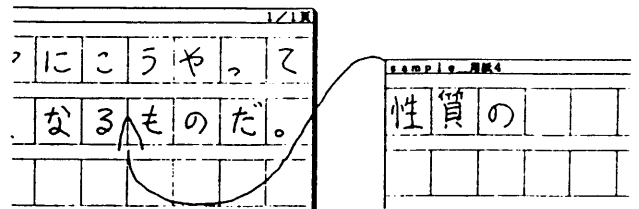
It is worth noting that there is a need to apply the segmentation using the overall patterns formed by all the strokes written on the tablet, and because of this, it is favorable to have the interface consolidated with lazy recognition.

REFERENCES

- [1] Anderson, J. R. Cognitive Psychology and its Implications. 2nd ed. W. H. Freeman, N.Y. (1985).
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Writing of insertion gesture.



After a linkage line is drawn, a new manuscript paper is displayed on which additional writing is made.

Figure 1. An example of text insertion.

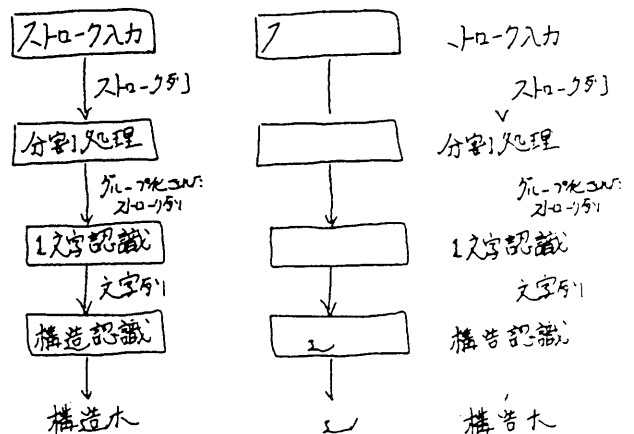


Figure 2. Segmentation of characters and diagrams.