

User Interface Design for a Mokkan Reading Support System

Yasutaka TONE¹, Akihito KITADAI², Masato ISHIKAWA², Masaki NAKAGAWA², Hajime BABA³ and Akihiro WATANABE³

¹Department of Computer and Information Sciences,
Tokyo University of Agriculture and Technology, Japan. archaea_tone@hands.ei.tuat.ac.jp

²Tokyo University of Agriculture and Technology,

³National Research Institute for Cultural Properties, Nara

Abstract. This paper describes user interfaces of a system for helping archeologists decode *mokkans*. A *mokkan* is a wooden tablet excavated from ruins in Japan. Decoding *mokkans* is important to study the history, but they are damaged and stained with handwritten characters badly degraded. Therefore, it is very difficult even for expert archeologists. The system for helping them has three components of image processing, character recognition and information retrieval. The image data processing makes *mokkan* images easy to read. The character recognition presents characters candidates from unclear *mokkan* images. The information retrieval provides candidates of place names. In this paper, we present two types of User Interfaces for this system. One is a multi-window interface and another is a tiling-window interface. The former has higher flexibility. Archeologists can position and expand windows freely as they like. The latter has less flexibility, i.e., being unable to change windows like the former, but does not bother archeologists to operate them. As the result of an evaluation experiment by archeologists, both the interfaces obtained high evaluation, however, the latter was basically preferred in respect of ease of use and ease of understanding with some exceptions. This paper also presents a display method of multiple candidates of decoding.

1. Introduction

A '*mokkan*' is a wooden tablet on which text was written by brush in India ink. *Mokkans* were widely used in Japan at the Nara era (A.D. 710 – 794). The total number of *mokkans* excavated in Japanese ruins is about 320,000 pieces, and 170,000 pieces or more of them are excavated from the ruins of the *Heijokyo* palace site in Nara. Decoding *mokkans* is very important to know lifestyle, flow of materials, relations among regions, condition of economy and so on of that time. However, excavated *mokkans* are damaged, stained and sometimes broken into pieces so that character images are rarely kept completely. It is difficult for even expert archeologists to read *mokkans*. *Mokkans* already decoded remain at the order of ten thousand. The number of undecoded *mokkans* is increasing owing to excavations while the number of experts is decreasing. Therefore, we proposed a system to help archeologists decode *mokkans*. This system employs image processing, character recognition and information retrieval as shown in Kitadai et al., 2005.

We think it is necessary to give easy-to-use User Interface for the archeologists so that they may effectively utilize these functions. Especially, we think it is important to reduce time and effort required for operation without sacrificing the archeologists' intuitions. We propose two types of GUI - multi-window interface and tiling-window interface for this system.

Section 2 describes *mokkans* in some detail and problems in decoding them. Section 3 presents our system. Section 4 describes two types of GUIs for this system. Section 5 presents evaluation and result.

2. Details and Problems in Decoding Mokkans

To read scripts on a *mokkan*, archeologists extract ink from the *mokkan* or its picture first. However, very often, ink has been blurred, damaged or missing because:

- (1) Color of ink has been faded out or decolored.
- (2) Color boundaries between ink area and the background (skin of wood with grain) have been vague since the surfaces of wooden tablets have become dark and stained.
- (3) Some parts of a *mokkan* containing ink have been broken and lost.

For these reasons, the archeologists have to make conjectures or hypotheses on the lacked ink parts.

The archeologists had been using commercial image processing software for decoding when needed. For example, they have been used "©Adobe Photoshop". However, this makes decoding work interleaved and disturbed. Powerful image processing suitable for *mokkans* must be incorporated into the support system.

Another problem with decoding *mokkans* is that the archeologists have to consult many dictionaries and books on character patterns, place names, people names so on as shown in Figure 2. They are also interruptive for them. The support system should help them consult appropriate information without interrupting their thinking.

Yet another problem is that the archeologists draw pictures to decode a *mokkan* as shown Figure 3. Drawing and writing is part of decoding so that the support system should provide pen interfaces.



Figure 1: Examples of *mokkans*. These are very rare case that *mokkans* maintain the shape of themselves, or the text on themselves.



Figure 2: mess of documents necessary for decoding.

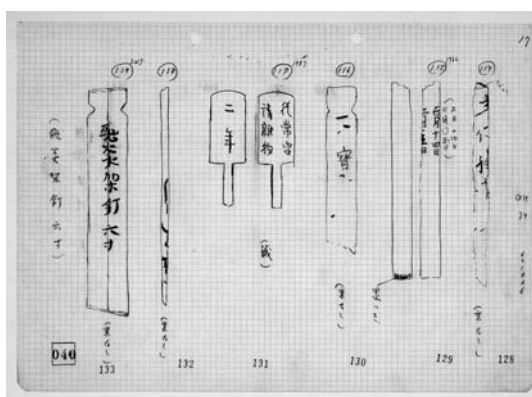


Figure 3: Drawing for decoding *mokkans*.

3. Support System for Decoding *Mokkans*

The support system gives three functions – image processing, character recognition, and information retrieval – to the archeologists as shown in Figure 4 where IP, CR and IR denote Image Processing Library, Character Recognition Engine and Information Retrieval Module, respectively.

Image processing makes unclear *mokkan* character images clear as much as possible. Character recognition gives the candidates of recognition result a *mokkan* character image. Information retrieval reduces chores for retrieval.

4. Proposal of GUIs for the Support System

We need to provide the GUI which makes three functions cooperate effectively. We propose two different types of GUIs, a multi-window type shown in Figure 5 and a tiling-window type interface shown in Figure 6. The former has higher flexibility. Archeologists can position and expand windows freely as they like. The latter has less flexibility, i.e., being unable to change windows like the former, but they are not bothered by window operations. We think that archeologists may need a system which is easier to understand, even if, it sacrifices the flexibility. Some archaeologists don't like operations of a computer. We prepared a function that users can change layout of tiles freely, but it was not mounted at this time. It is because we wanted to make a difference if possible between the two interfaces. Instead of providing this function, we designed the best layout of tiling windows from our walkthrough prototyping so that the archeologists can use the system easily. At the center of system area, they can see the tile of a *mokkan* image, and areas of other functions are surrounding the center area as shown in Figure 6.

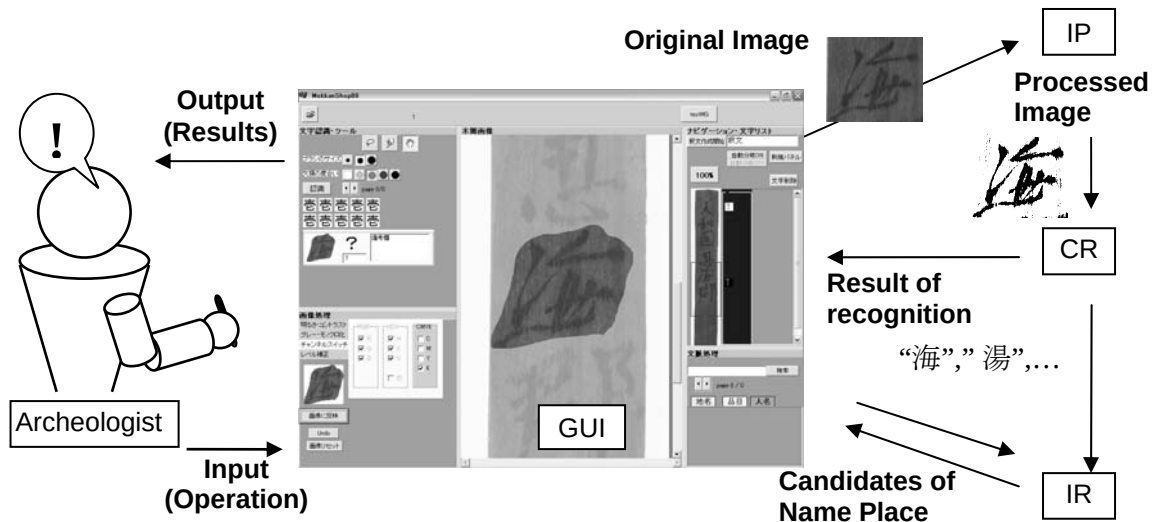


Figure 4: Concept of system.

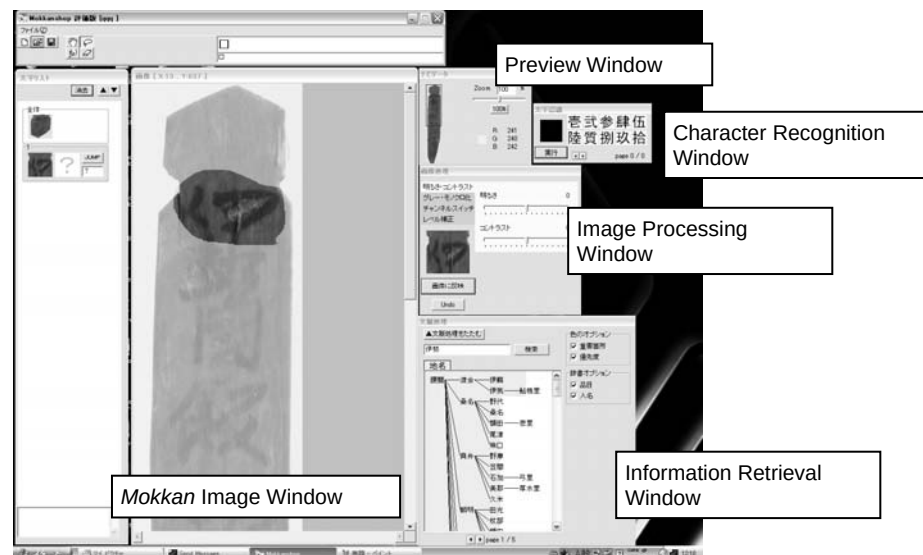


Figure 5: The screen shot of the system with multi-window interface.



Figure 6: The screen shot of the system with tiling-window interface.

5. Result of Evaluation

We asked four archeologists to test both the interfaces. As a result, both the interfaces were basically appreciated. As we expected, however, they expressed the opinion that the multi-window interface was annoying. On the other hand, each archeologist had his/her own favorite layout of the tiling windows. The function should be mounted so that the layout of tiles can be edited freely.

As for the functions, the archeologists appreciated all the three functions, especially, information retrieval.

6. Conclusion

We proposed two GUIs for the support system to help archeologists decode *mokkans*. The system has three components of image processing, character recognition and information retrieval. Two types of User Interfaces is either a multi-window interface or a tiling-window interface. The latter has less flexibility but the archeologists showed their preference to the latter since they were not bothered by window operations. On the other hand, each archeologist had his/her own favorite layout of the tiling windows so that the layout of tiles should be changeable freely.

We are planning to avail our system to 30 researchers on *mokkans* with the interface proposed in this paper. Then we will evaluate this system and these interfaces.

At this moment, the system is being used at the desktop environment, but it must be usable where *mokkans* are excavated. Moreover, archeologists have been using pen and paper for decoding. They draw pictures of *mokkans* and write down ideas and hypotheses. Therefore, we are interested in preparing the system on pen-based computers and provide pen-based interfaces.

Acknowledgement

This work is being supported by the grant-in-aid for scientific research under the contract number S-15102001 and the grant-in-aid for young scientists under the contract number B-19720202.

References

- Akihito Kitadai, Kei Saito, Daisuke Hachiya, Masaki Nakagawa, Hajime Baba and Akihiro Watanabe: Design and Prototype of a Support System for Archeologists to Decode Scripts on Mokkan, Proc. 13th Conference of the International Graphonomics Society (IGS), Salerno, Italy, pp.54-58, (2005.6)
- Ben Shneiderman: Designing the User Interface: Strategies for Effective Human-Computer Interaction, Addison-Wesley Longman, Incorporated (1992).
- J He, Q Do, A Downton, J Kim: A Comparison of Binarization Methods for Historical Archive Documents, 8th International Conference on Document Analysis and Recognition (ICDAR), Seoul, Korea, pp538, (2005.8)
- Jin, X.Y: Sketch-based User Interface Study, Master Thesis, Nanjing University, China, (2002).
- S Feng, R Manmatha: Classification Models for Historical Manuscript Recognition, Proc 13th Conference of the International Graphonomics Society (IGS), Salerno, Italy, pp528, (2005.6)