A Revised Human Interface and Educational Applications on IdeaBoard

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ABSTRACT
Our video demonstrates a new style of human interface with an interactive electronic whiteboard. Its design goal is to realize easy and natural operation of a large board from an arbitrary standing position of the user with a reasonable amount of hand movement, with no hiding of the board by the user's body. We have been attempting to attain this goal by smoothly and naturally extending the current desktop GUI rather than relying on unreliable gesture commands.

Keywords
pen interface, electronic whiteboard, education, handwriting recognition, direct pointing, GUI

INTRODUCTION
A white/black board is a device that is not yet fully computerized although it may allow new styles of presentations and lectures.

We decided to develop a system which combines the merits of white/black boards and those of computer processing as a part of our pen interface research [2].

The Liveboard by XEROX PARC is well known as such a system [1,3]. Our system differs from the Liveboard in the following respects.

Firstly, the Liveboard and its applications developed at PARC avoid handwriting recognition except for gestures [3]. In our system, we employ handwriting recognition whenever and wherever effective.

Secondly, the Liveboard uses gesture commands while we have been trying to avoid them. Gestures have simple shapes but simple shapes are hard for machines to recognize. There is little context to augment gesture recognition. Moreover, misrecognition of gestures or forgetting to set an appropriate mode before inputting gestures can yield an abrupt and unexpected result so that it not only interrupts lectures or presentations very badly but also make the user afraid to use gestures.

The gesture-command approach would have been tried to solve the problems caused by a simple expansion of the desktop GUI to the board size, but we try to enhance the desktop GUI to make it suitable for a large interactive display and electronic pens.

Thirdly, the Liveboard seems to be oriented for meetings and presentations, but our system is mainly designed for educational use.

We started our research using temporary hardware to develop software while preparing new hardware. We call our system *"IdeaBoard"* (Interactive, Dynamic, Electronic Assistant Board).

TWO TYPES OF IDEABOARD
IdeaBoard-I was composed of a 70-inch tablet with three pens and an eraser, an LCD projector and a PC. The display of the PC was projected onto the tablet from the LCD projector. When it was composed, LCD projectors on the shelf were dark and poor in resolution. Moreover, this organization makes the user's body block the projection.

IdeaBoard-II shown in Figure 1 is composed of a rear-projection 70-inch High Vision TV and a pen sensor on its surface. The TV has the resolution of 2000 x 2000, 680 cd/m^2 brightness and 180:1 contrast rate but currently used

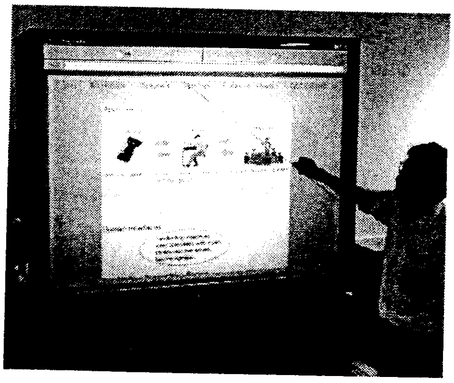

Figure 1. *IdeaBoard-II* for WWW Browser.

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at 1600 x 1200 resolution due to the display control board. The pen has top, side and bottom switches so that even its bottom can be used for special marking. The less the number of switches, the simpler it is for the user. But, the three buttons are prepared to test several possibilities. The pen has a 7-bit identification tag so that 128 pens can be used.

Recent remarkable progress in projection technology has made the organization of the *IdeaBoard-I* cost effective.

DESIGNING IDEABOARD UI

If we just expand the desktop GUI to whiteboard size, the teacher has to move from side to side, stretching hands from button to button, which not only makes the teacher dance but often hides the board from the students. On the other hand, GUI is an already established HI principle and we are very accustomed to it. Therefore, we reconsidered the components of the desktop GUI and modified them so that a better GUI for large interactive whiteboards can be realized.

If the body movement to operate the *IdeaBoard* is too large, it is hard for the user as well as it hides the board, but if it is too minute, it is again difficult for the standing user. We think that a reasonable amount of body movement with direct pointing and manipulation is not only natural but also appealing to the audience.

To keep pushing a pen horizontally at one point on a vertical board is hard. Our hands become tired in trying to remain steady. Single tapping might become double tapping. Double tapping is also not so easy as with a mouse. Compared with these, dragging (drawing) a pen is easier and more direct for the audience. We may add the meaning to the directions in which the pen is dragged.

Displaying a menu at a fixed position on the large surface makes the user move to select the menu. Moreover, fixed menus occupy certain spaces and make the display complicated.

When you start to use an application on common desktop GUIs, a window for it will come out somewhere on the screen and you will have to move or resize it to your preferable position and size. This is inconvenient on a large display since you have to move to the place where you can control the window.

Smooth and continuous movement of displayed objects [4] seems more important for the shared large display so that the audience can keep their focus of attention without being annoyed by sudden changes of contents.

Although the styles and components of the desktop GUI must be modified based on the above considerations, the modification should be very natural so that users do not feel a big difference.

APPLICATIONS AND COMPONENTS

Based on a study of the current GUI components and our previous prototyping on *IdeaBoard-I* [2], we have made 17 UI components in order to develop applications efficiently.

The video shows several applications where the new UI components are effectively employed. It starts from *IdeaBoard-I* then moves to *IdeaBoard-II* for showing calculation and programming education by handwriting. *IdeaBoard-II* is brighter to our eyes but flickers to the camera so we come back to *IdeaBoard-I* afterward.

The application starter allows the user to set the position and size of its window by a continuous pen action. The image viewer employs resize and scroll controls. When the user select either of them, the other area will disappear and the user can change the view while showing as much area as possible. The book viewer uses page-turning control. The calculator by handwriting employs text-input controls. This application shows wrong parts of an arithmetic expression with red color. The programming education is an example where handwriting recognition is useful. The roulette is used to select a student to answer. It employs a new spin button. The teaching materials are hidden as little as possible by this application.

Then, the video compares 6 typical new UI components with the conventional components, i.e., spin button, scroll, check box, radio button, window move and list box.

The extensible pointer realizes the window move. This is a departure from direct pointing but can also be considered as a magic "hand" so that it is an extension of direct pointing. Its appearance has been shown in Figure 1.

CONCLUSION

This extended abstract has presented our motivation for developing *IdeaBoard* as well as a summary of applications and UI components. Preliminary evaluations show that the *IdeaBorad* UI style and components seem well suited for large interactive and electronic whiteboard systems.

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