2006-1220: EFFECTIVE CLASSROOM PRESENTATIONS USING WRITEON

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Effective Classroom Presentations Using WriteOn

Abstract

In this paper, we discuss an advance in technology-aided instruction. Not limited as in the past to PowerPoint-based or white board-centered electronic ink applications, the new tool, WriteOn, allows the instructor to use electronic ink to annotate on top of any application visible on the tablet PC display screen. This tool can be useful in improving both the presentation of information as well as the interactivity in classroom instruction. Previous research in this area led to the development of tools that are PowerPoint®-based applications, or electronic ink-based alone applications. Some allowed the presenter to broadcast slides and electronic ink to class while others are simply a presentation tool. Previous applications do not allow the presenter to annotate contents displayed or executing on the screen, nor to simultaneously broadcast the desktop screen activity. Using WriteOn, the instructor can choose to broadcast the dynamic screen contents along with electronic ink in real-time. Alternatively, the WriteOn user can save the ink annotations and desktop activity as a movie file (or individual screen captures) and then later broadcast these files to the students. Students receiving the broadcast presentation may save the file on their local machine. WriteOn is also capable of recording audio captured on the presenter's machine and synchronize it to the annotation ink strokes. Using WriteOn, the instructor can enhance the real time experience of any concept or program being taught through annotations on the screen.

Introduction

Effective lecturing is a daunting task for many instructors attempting deliver complex and voluminous amounts of information to students. Instructors use various techniques to make the lecture more interesting and yet communicate the important points of the subject matter. Some of these techniques involve the use of a classroom blackboard, a projector for static and animated display, multimedia, etc. But the presentation methods listed above either lack the ability to easily save lecture information or the ability to perform high quality and comprehensive note-taking. Note-taking is an important factor for an effective learning process because it helps the student to process information as they record it for later review. Re-examination of their personal notes is an important process for students to undertake in order for them to better understand the concepts presented in the classroom In many cases what is very important to the student is the process of developing a concept and this process is occasionally difficult to record in standard pen and paper note-taking paradigms. Computer-assisted teaching provides a viable solution for all of these problems.

Computer-aided teaching (or Computer-assisted teaching) can be used to greatly enhance the teaching/learning process. Rune Kornefors and Lennart Lundberg explain the importance of computers for efficient teaching their paper[1]. Microsoft's PowerPoint® is predominantly used by instructors for classroom presentations. PowerPoint® gives a structured approach to the lecture, but does not facilitate note-taking, nor does it allow an instructor to incorporate dynamic elements and demonstrations into the presentation. Word processors such as Notepad®, WordPad® or Word® can all be used for structured note-taking however, instructors and students often have difficulty in taking notes using these tools for this purpose since they do not use free

hand writing and as such are slow and rigid. Tablet PC-based tools such as OneNote[®], Journal[®] and Classroom Presenter[2] have been developed using a real-time stylus as a more natural input device in order to enhance note-taking. In Classroom Presenter, the ability to apply electronic ink on lecture material originally formatted as PowerPoint slides is a very powerful capability that is destined to replace conventional note taking methods. Steven A. Wolfman in his paper[3] goes into detail about several advantages the Classroom Presenter tool and describes how it can be used in a classroom scenario. Further examples of the use of Classroom Presenter and its benefits are found in papers Wilkerson, et al.[4] and Tront[5]. These papers describe how Classroom Presenter is used in an active lecture, demonstrating how these tools enhance the learning process with such features as instructor electronic inking on the lecture slides, student annotation on personal copies of lecture slides, and in-class student submissions of the ink annotations as part of active learning exercises.

Endeavors to incorporate active learning into engineering courses have become more widespread over recent years. Lecturers are using techniques such as *minute papers* and pair-share-and-compare exercises to enrich the learning environment[6,7]. While these techniques show very good results when properly implemented, many instructors feel they are not capable of effectively conducting these exercises. Typical reasons range from lack of classroom moxie, to unfamiliarity with a technique, to large numbers of students in a lecture, to the perceived need to fully cover an over-packed syllabus. The new tablet PC-based tools being developed can help instructors to overcome some of the difficulties mentioned above and allow them to perform more active learning exercises. For example, Classroom Presenter facilitates students' sharing exercise solutions with the rest of the class through the built-in *student submission* facility[8]. The new tool WriteOn can also be used to overcome these difficulties as will be discussed later in the paper.

Annotating presentation information using a real-time stylus is a powerful feature by which one can illustrate and elucidate the lecture topic by inking on pre-drawn text, pictures or drawings. However, the ability to annotate on any application further enhances the capability of the lecturing by not restricting the instructors to only static displays of prepared images. For example, instructors teaching a topic like programming can more effectively explain their subject if they could demonstrate the execution process in real-time to the class by showing output of a simulator. The new tool WriteOn adds the ability to annotate on top of the screen displaying the changes within the simulated computer hardware as the simulation takes place. Many other topics in various subjects can be better explained using this type of facility. Use of this capability is a significant step forward in effectively informing students of the dynamic behavior of typical engineering processes.

Related Work

Much work has been done in developing technologies to aid in the presentation of the lecture. One such effort is underway at the University Of Washington under the guidance of Prof. Richard Anderson[2]. The outcome of his work is a software tool called Classroom Presenter. This tool is a PowerPoint[®]-based application where the instructor and the students can ink on static presentation slides originally containing text, drawings, or electronic ink. Typically, the instructor prepares a lecture in PowerPoint and converts it to Classroom Presenter file format. In

class, computer equipped students and the instructor connect to a virtual classroom allowing them to interact. Lecturing takes place with the instructor using the prepared presentation to guide the discussion while at the same time making electronic ink annotations on top of the lecture slides. The electronic slides can be received by students in the audience, and those with tablet PCs may apply their own electronic ink on top of the static PowerPoint slides and on top of the instructor's annotations. Copies of the slides and ink local to the student machines may be saved as class notes for later student review.

One of the more powerful features of Classroom Presenter is the ability to perform student submissions. Using this feature, lecturers may pose a problem to the class and request that they work on a solution to the problem and then submit it to the instructor. The instructor may then display selected student submissions to the rest of the class on the classroom presentation screen and develop a discussion around various opinions or competing solutions to a problem. Having used this capability in a course titled Introduction to Computer Architecture, the authors have had much success in energizing the class and increasing the participation in lecture activities. An example of a student submission in which students were asked to complete a simple logic design is shown in Figure 1. Upon displaying the submission, the rest of the class was asked to verify its correctness, seek a more minimal solution, or proposal alternative solutions. Students were very eager to participate in these types of exercises.

Although classroom Presenter and other similar tools provide very good platforms for presenting static information, they lack the ability to display and provide for interaction on dynamic and spontaneous computer displays. It is the goal of the WriteOn tool to fill this gap.
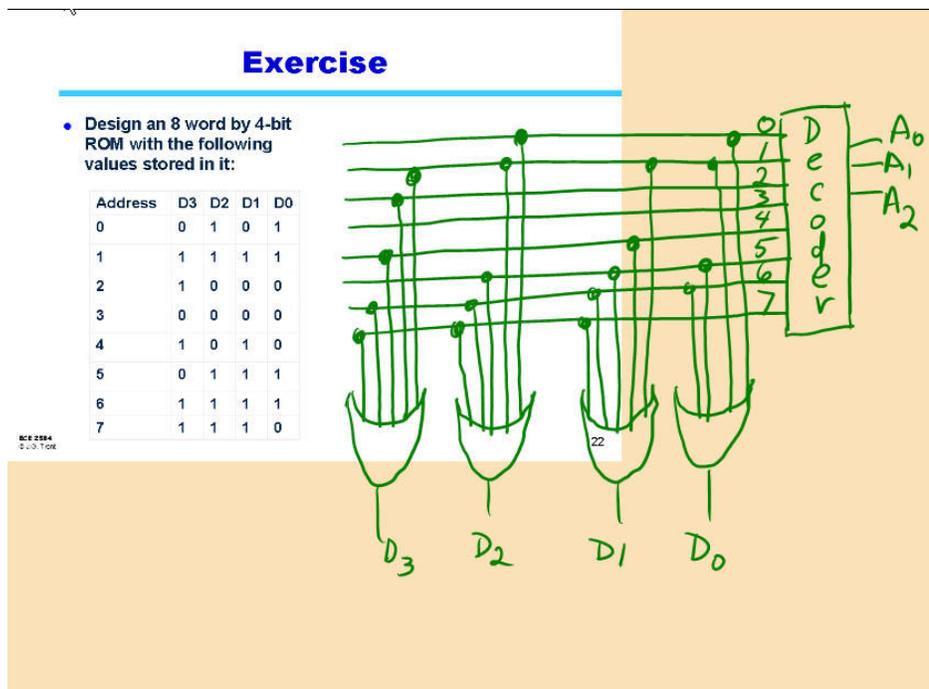
Figure 1 Student submission for classroom interaction exercise.

Tablet PC Environment

A Tablet PC provides an easy and flexible environment for making computer-based presentations. It can be used in typical notebook computer fashion, or it can be folded to be in tablet mode making it an easy to use as a writing slate. Moreover, it is very light weight and easy to carry so that an instructor can move around in the classroom to better work with individuals or groups of students. There are several buttons on the typical tablet screen which can be configured to perform functions specific for each particular application making it easier to give presentations. Tablet PCs also have built-in wireless adapters that are becoming much more commonplace in portable computers. Finally, long battery life is another feature typically seen in tablet PCs, ensuring that students can use them throughout typical class days even though few of the typical lecture halls have sufficient power connections available.

The WriteOn Tool

When used in conjunction with a tablet PC, WriteOn, allows the instructor to utilize electronic ink to annotate on top of any application visible on the tablet PC display screen. This capability can be useful in improving both the presentation of information as well as the teacher-student interactivity in classroom instruction. Using WriteOn, the instructor can choose to broadcast the dynamic screen contents along with electronic ink in real-time. Alternatively, the WriteOn user can save the ink annotations and desktop activity as a movie file (or individual screen captures) and then later broadcast these files to the students. Students receiving the broadcast presentation may save the file on their local machine. WriteOn is also capable of recording audio captured on the presenter's machine and synchronize it to the annotation ink strokes. Using WriteOn, the instructor can enhance the real time experience of any concept or program being taught through annotations on the screen.

Figure 2 shows a logic simulation using the application LogicWorks®. WriteOn is active in this display with a virtual transparency, referred to as electronic vellum (e-Vellum), shown placed over the screen surface. Several ink strokes are applied as annotations. LogicWorks is a typical tool used in learning digital logic design, providing an electronic circuit simulation environment that assists designers draw and analyze digital logic circuits. The large central area shows the circuit to be simulated; the bottom area (also called output area) shows the simulation output changing states between logic zero and logic one. The output waveforms basically move from the right side to left side of the output area. The instructor's ink strokes explain the simulation output at various points in time. Obviously this type of operation can be explained by capturing sequences of output and setting the image files in a PowerPoint presentation. However, it is much more informative to have a dynamic display that shows annotation as the simulation process is running enabling the students to pose and the instructor to respond to what-if question in the class. As seen in the figure, using WriteOn, an instructor can annotate on any region of the vellum to explain the various features of LogicWorks such as the operational commands, the gate layout, the simulation output, etc. To erase the ink the instructor has but to invert the stylus of the Tablet PC and make an erase gesture, the same as is done with a pencil eraser.
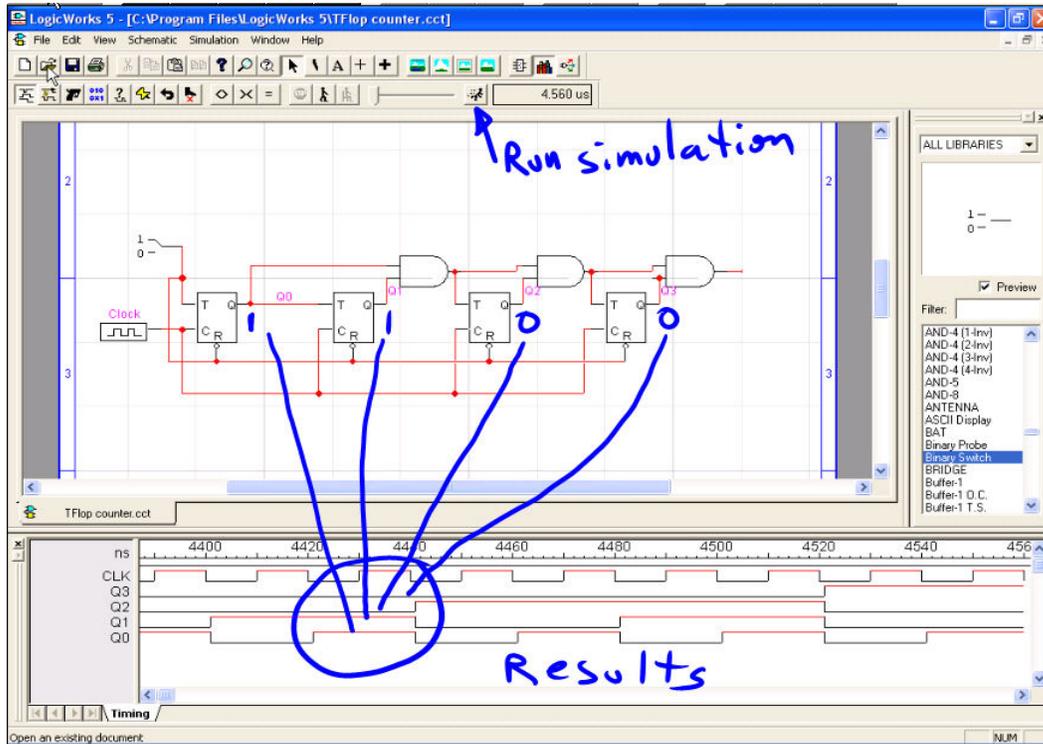
Figure 2 WriteOn annotations over the top of an operating Logicworks simulation output window.

To input commands to the application program, in this case the LogicWorks simulator, the instructor can execute a command to "pierce the vellum". This operation effectively cause input from the stylus device to be applied to the application program. Switching modes is done by right-clicking the WriteOn icon in the system tray (generally lower right of screen) and then clicking on the Pierce Vellum menu item. Spontaneity is brought to the lecture by the pierce vellum mode which allows the presenter to adjust parameters in the application program, to pose new simulation situations, or to respond to student what-if questions. Vellum is placed back on the screen by again right-clicking on the WriteOn icon in the system tray and clicking on the Show Vellum menu item. Once the vellum is returned, the instructor may again draw on the screen, annotating points of emphasis and supporting student cognition.

WriteOn allows the user to capture individual screen images for use in subsequent review of material presented in the lecture. Clicking on the camera icon, visible in the upper right hand side of the screen when e-vellum is present, causes the image capture process to begin. The user can also execute an image capture by using the WriteOn menu from the system tray. On the first execution of an image capture, WriteOn requests the user to choose a directory for storing the images. The user provides a filename and subsequent snapshots use the same name prefix and append a sequential number to differentiate one snapshot from another. In this way the user can organize image content areas perhaps using one directory for each lecture as you might use dividers in a pen and paper notebook. Once the snapshot is taken the instructor can choose to

clear all the ink strokes or just remain in the same state as before with all the strokes remaining on the vellum. The tool also provides the facility to change pen options such as width, color, etc.

WriteOn also offers the option of capturing a movie of the presentation session. Movie capture begins when the user clicks on the Start Capture item in the WriteOn menu. Parameters for the movie capture can be adjusted in the Properties WriteOn menu item. Movies can be captured at various frame rates and resolutions. Two different video compressors are available: Direct X or Windows Media Encoder. Once a movie capture begins, the menu item toggles to be Stop Capture allowing the user to end the capture operation from the same convenient menu location. Movie file size depends on the compressor used, the resolution chosen, and the frame rate. Movies can be distributed to students allowing them to follow the processes that might be explained in a typical class.

Audio of the class lecture can also be captured with WriteOn. Using the Audio tab on the Properties menu item, the user can request that audio be captured along with the movie of the screen interaction. Again, this mechanism is useful in allowing students to review the problem solution processes that are typically demonstrate during lectures

Presentations displayed on the instructor's screen may be broadcast to client systems on student machines using the Broadcast capabilities of WriteOn. First, the instructor and the clients must use the Connect menu to choose a multicast Venue for the session. By clicking on the check box in the Common tab of the WriteOn Properties and then clicking OK, the broadcast session begins. Essentially a movie of the screen activity is sent to each client. Students receive the movie and are able to add their own annotations to what is shown on the instructor's screen. The resultant localized movie can be stored for later review.

The simple command set and the gentle learning curve makes WriteOn easy to use and not at all intimidating to typical instructors. Simplicity in the tool allows the instructor to spend time investigating effective use scenarios tailored to the lecture topic/material, to the class size, and to other factors which generally dictate adjustments that good teachers regularly make to their delivery style.

Testing and Results

WriteOn has received initial testing in a classroom environment. It was used to demonstrate principles described above in the discussion of the logic simulator LogicWorks as shown in Figure 2. WriteOn was also used during the discussion of the simulation of a simple microprocessor system in the Introduction to Computer Architecture course. Operation of an assembler/simulator software package called MPLAB was described to the students. A screen capture of a typical presentation display is shown in Figure 3. This figure shows how the instructor can use WriteOn to apply electronic ink to a virtual transparency lying over the top of the simulation application window. Note that the simulation continues to run underneath the virtual transparency and that the students are able to continue to follow the animation of the simulated processor operations even as the instructor writes notes on the screen.

One instructor taught two different sections of the class. In one section he used WriteOn to assist in explaining the operation of the simulator. WriteOn was not used in the second section. Using WriteOn greatly enhanced the ability to explain and demonstrate details of the operation of the simulator. Several suggestions were obtained from the instructor on ways to improve the usability of WriteOn.

Feedback from the students has been very positive. They indicate that having the ability to receive the annotated screen images after completion of the class is quite valuable to their studies. A monitoring of the FTP site used to make downloadable files available indicates a high volume of traffic. Unfortunately, we cannot determine who downloads or how many times the same person downloads, but we plan to be able to collect this type of data at a later date.
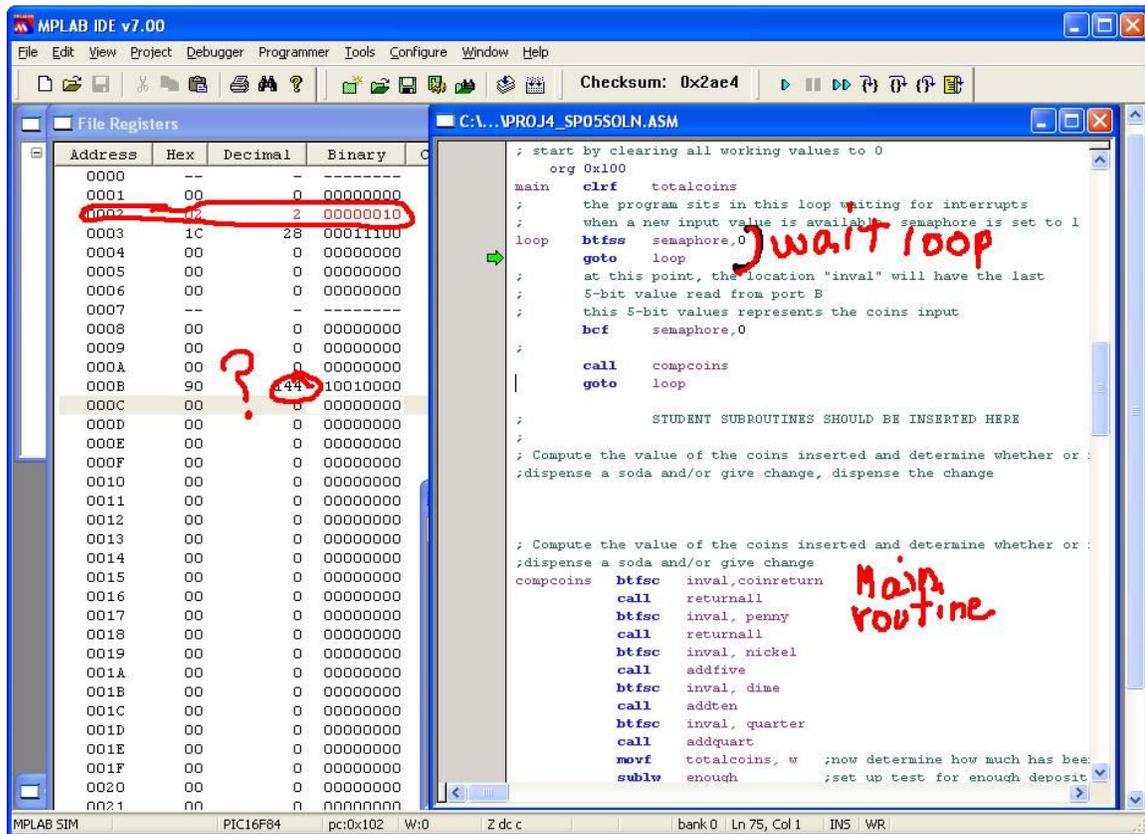
Figure 3 Assembler Simulator screen capture with WriteOn annotation.

Conclusions

Significant work has been done in building the WriteOn system for use in improving classroom presentations. One of the major goals of the tool is to facilitate active learning opportunities in the classroom.

WriteOn is built using Microsoft Ink technology for annotation, DirectShow and the ConferenceXP SDK for capturing and broadcasting electronic ink (e-ink) and desktop screen activity. The initial development process took about one year. We are currently releasing free copies of the software for beta testing and encourage new users to provide feedback to the developers.

Based on positive feedback from initial users, we believe that once the tool is fully developed and deployed, it will help to improve the effective teaching and learning processes employed by instructors and students. One of the value-added features that this project will focus on in the future are: improving the efficiency of generating movie files during the capturing operation. Currently files are somewhat large and have an occasional dropped frame due to machine speed variations. Another area for improvement is the slight lag in video streaming to networked users. We will look at the compression filters to help make improvements in this area. During more extensive user testing, the user interface will also be examined to identify areas for improvement in usability. A free copy may be obtained at www.ee.vt.edu/~jgtront/writeon/

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