Work in Progress - Enhancing On-Line Interaction with Graphical Tools

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Abstract - A limitation in many on-line interaction systems (discussion boards, wikis, chat rooms, etc.) is the lack of graphical tools. When using these types of systems to provide asynchronous help for engineering classes, the lack of integrated graphical tools ignores the need to communicate with sketches and equations. Due to the nature of the material and the limitations of current technologies, students tend to work in a mixed-mode environment. That is, they will work out their solutions to problems on paper, and then they have to duplicate or describe their work in a text only mode when they go on-line for assistance. The requirements, design, and implementation of a prototype system for allowing students to seamlessly integrate images, sketches, and equations along with text in on-line discussion board environment is described.

Index Terms – Discussion board, chat, on-line, homework, graphical tools.

INTRODUCTION

One of the major challenges of teaching a large (400+ student) class is the coordination and management. To that end, we run our own web site with a class management system. Running our own custom web site has been an invaluable tool, both from the organizational perspective, and from the pedagogical perspective, in that it allows us to easily try new things that would be difficult or impossible with a packaged system. Part of the functionality of our web site is an online discussion board that is integrated with an on-line homework system. Students, as they are working a homework, can directly access the discussion board and view all (students and instructors) questions and answers about that particular problem. During the Fall, 2010 semester a 450 student class – EF 151 Physics for Engineers I – had over 3100 posts and 75,000 page views on the discussion board. Only about 25% of the students were active users, but based on formal and informal feedback, many more were passive users. Students obviously make good use of the discussion board in its current state. In addition, the discussion board allows the instructors to efficiently interact with many students and to see what they are struggling with.

Discussion boards have been shown to have a positive impact on student learning in on campus courses [1]. However, the discussion board capabilities of commercial systems such as Blackboard and Moodle are primarily text based. We are continually reminded of the need for a ‘graphical discussion board’ when a student would try to describe their ‘picture’ of a problem and/or a solution in words. It could be an actual picture (free-body diagram) or a mathematical equation requiring many special symbols. “Draw a good picture” was a common answer to a student’s question. That skill – formulating the definition of a problem with a picture – is a very important skill and one that has lost some emphasis as the use of an on-line homework system has become the norm for many large classes. A combination discussion board and sketching utility have been used in other courses [2], but we were looking for ways to integrate the two, and use modern tools (e.g. picture texts) to communicate using pictures.

PICTURE TEXT

We want to extend our existing text based discussion board to allow the inclusion of graphics. A logical first step would be to allow students to associate images with their discussion board questions. This leads to the question of how students can get images to the web site. The proliferation of sites like Facebook, YouTube, Flickr, etc. means that that capability exists and that we have to make our site as easy to use as those.

A recent survey of our current EF 151 class shows that three-fourths of the class have the ability to send picture messages with their cell phone. In addition, today’s cell phones all have reasonably good cameras that can take legible pictures of normal size paper (Figure 1). That fact, coupled with our use of a custom web site for our class, allows us to set up a system in which the student can easily send pictures of their work.

Students register their device with their class account which results in the device’s email address being mapped to the student’s netid. The process is structured to ensure that only valid combinations are enabled. Once this one-time registration is complete, the student can simply pix message or email an image to the web site and it will automatically be loaded and available for inclusion in a discussion board thread. The magic is enabled by a web site PHP script that processes incoming mail and keys off of the sender’s email address and automatically saves all attachments for the associated student.
Figure 2 shows a couple of examples of the results of using various homework problems is transparent objects. We can annotate either with freehand or with capabilities. We now these were all resolved. Many technical issues in implementing this solution, but there were found that were simple and easy to implement, thus a basic web-based system was created.

The key was identifying available components and tying them together. The final result was single PHP script that provides for cropping, scaling, rotating, and brightness adjustment. A standard Linux utility, ImageMagick [3], does all the image processing and the PHP script provides the user interface. The hardest part of the user interface was providing a method for the user to specify a cropping area. A Javascript utility called Jcrop [4] was a ready-made solution. We continue to be amazed at the quality and usefulness of open-source utilities like these.

**Annotating Pictures**

With an easy way of getting a picture of a student’s work to the web site, the next challenge was providing an easy way of annotating, or marking up, the picture. This will be used mainly by instructors and graduate teaching assistants to provide annotation on students’ work. Many different approaches were considered, but the one that was chosen was to use a browser-based open source editing utility called svg-edit [5]. SVG is a standard that’s been around for over 10 years, but it isn’t widely known. It stands for scalable vector graphics. The primary technology for the implementation of svg-edit is the fact that the HTML 5 specification includes a ‘canvas’ entity which allows for the display of SVG files. In addition, the canvas object is accessible by Javascript, and thus the svg-edit is a Javascript application that provides an interface for editing. There were many technical issues in implementing this solution, but these were all resolved.

The end result, however, is fairly impressive in its capabilities. We now have a web-browser based utility that can annotate either with freehand or with basic graphics objects. All the management of files is integrated within the web site so that the file names and associations with the various homework problems is transparent to the users. Figure 2 shows a couple of examples of the results of using svg-edit both to create a new image and to annotate a photograph of a homework.

**FIGURE 2**
*IMAGES CREATED AND ANNOTATED WITH SVG-EDIT*

**Summary**

The graphical tools have been implemented into the discussion board for two freshman engineering classes as well as the discussion board for a graduate level design class. Students are picking up on the capability and using it more and more. Anecdotal feedback has been positive and we have many examples of how a problem was identified and resolved in a fraction of the time that would have been required using a text-based discussion. Suggestions have been made to allow for other formats (Excel, Matlab, etc.) to also be supported. Formal feedback will be solicited at the end of the semester. Finally, collaboration with others classes and schools is being solicited. To facilitate collaboration access to a demo system can be obtained by contacting one of the authors.

**Acknowledgment**

This work was partially supported through a Project RITE grant to the first author through the Educational Technology Cooperative of the University of Tennessee.

**References**


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