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Management and Archival for Project-Based Courses

Abstract:

The use of the World Wide Web has become very common as a teaching tool in courses. It serves as a paperless studio for both instructors and students. The use of this tool helps reduce the cost of a course tremendously for both parties as it reduces paper consumption and the cost of textbooks. In this paper, we examine the effective usages of database driven web portals for use in a first-year engineering design course. Specifically, we explore the pedagogic implications of creating two types of portals: (1) Course Management System (CMS) for course materials in an ongoing semester and (2) Project Archival Tool (PAT) for completed project materials.

We apply our proposed methods in a first-year engineering design course taught to approximately 180 students per semester. The course is project-based and focuses on teaching students basic engineering design principles and professional skills. Coupled with these lectures are additional laboratory components in which students learn to use MathWorks Matlab, a computational tool, and Alias Wavefront Maya, a 3D design package. The final team-based project encompasses skills learned in class applied to a design problem proposed by a community partner. Required of each team is a final presentation with electronic slides alongside a report. Additional deliverables are varied and may include website design, 3D architectural drawings and renderings, and physical prototypes. The significant amount of project material produced during the semester prompts the introduction of appropriate tools.

CMS is a calendar-like system for students and instructors to disseminate and collect electronic documents including lectures and assignments. Student submissions and grading are handled by CMS, resulting in a more effective and efficient course management. With its built in "Help-Ticket" function, CMS facilitates a rapid response and communication rate between instructors and students. Important project management features, for example a scheduling tool, a file-sharing facility, Gantt Chart creator have been incorporated into the system to better serve the need of team-based project work.

PAT is web-based archival system, which collects and makes available final deliverables of student projects. The data presented through this tool mainly serve to provide future students with prior projects' results, which is particularly important for continuing projects. It also serves as a method to relay progress and status to community partners and other interested parties. Consequently, PAT becomes a chronological encyclopedia of all projects that students have completed in our course.

Results indicate that the implementation of both portals yields a smoother paperless transition of materials not only between students and instructors but also between student teams and community partners. Student evaluations show satisfaction with the use of both systems while community partner evaluations show great enthusiasm for this easy access to completed project materials. Course instructors are comfortable with the simplicity of paperless course management. Future work includes implementation and assessment of additional project management tools.

Introduction:

The advent of the World Wide Web has become an invaluable resource to the educational society. Many professors have made this their primary teaching tool in courses. The effectiveness of the World Wide Web as a primary teaching method can be seen by the growth of distance learning courses offered by secondary institutions. This paperless studio facilitates teaching for both students and instructors. The use of the Internet diminishes the need to purchase textbooks and thus reduces paper consumption and inevitably the cost of taking a class. Furthermore, replacing the primary need for textbooks with course specific tutorials and lectures facilitates a more directed and personalized method of teaching.

The use of the World Wide Web is very prevalent in our engineering design course at Columbia University taught to approximately 180 students each semester. This one-term project-based course focuses on teaching students basic engineering design principles and professional skills. In conjunction with these lectures are additional laboratory components in which students learn to use software packages for computational needs (MathWorks Matlab) and 3D design renderings (Alias Wavefront Maya). Throughout the academic semester students have assignments relating to both the technical aspect as well as their final project. The course final project is team-based and encompasses skills learned in class applied to a design problem proposed by a community partner. These projects are known as service-learning projects since the client is a non-profit community organization. Deliverables required by each team include a final presentation with electronic slides with an additional written document report. Additional deliverables are varied and may include a website design, 3D architectural drawings and renderings, and physical prototypes. All projects require students to demonstrate their understanding of the course material and additional software packages used in class. Thus, the significant amount of project material produced during each semester prompts the introduction of appropriate tools to aid in management of student work while in the course and proper archival once the term has ended.

Course Management System (CMS):

Course Management System (CMS) is our calendar-like system that students and instructors use during an academic term. Table 1 shows the key management features of CMS. CMS also contains other additional features such as management of attendance records, student discussion boards, and grading.

Table 1: Key management features of CMS.		
	Students	Instructors
Course notes	Reduces money spent on buying textbooks	Effective method to distribute course materials without having to copy materials.
File sharing	Ease of transfer for project materials between teams.	Allows for instructors to post any supplemental course materials.
Help-ticket	Allows for students to send one email to receive rapid response. Eliminates the run	Reduces the workload for instructors, since the appropriate instructor can answer the request.

	around to find the appropriate contact person.	
Project Management Tools	Eliminates the need to purchase additional software.	Effective method to teach students objectives taught in the course.
Student Report Sheet	Allows for students know of their progress in the course at all times.	Allows for instructors to monitor students progress and help those needing additional attention.

Grading is a critical process that takes place during the academic term and thus there is a need for an easy method to grade all assignments. Figure 1 shows the grading interface used by instructors and teaching assistants. All assignments submitted can be viewed with a time stamp to determine whether assignments were turned in on time. If the assignment was not turned in by the assignment due date and time, the particular student's submission time is indicated in red as shown in Figure 1.

Different methods are implemented to meet different instructors grading styles. For instance, the grade sheet view as showing in Figure 1 displays the list of students on the roster based on the filter type chosen along with submission time. Instructors can easily fill in the text field next to the names with appropriate grades for the given assignment. The negative aspect to this view is that the student submissions cannot be viewed and feedback comments cannot be provided to students. This view is helpful for grading assignments solely on the basis of completion. The submission view of the grade sheet allows for instructors to view the actual submission, submission time, and provide feedback about the submission. Finally, the grade book feature shows a complete listing of every student grade and current progress for entire class. This also displays class averages for individual assignments as well as group course averages.

Figure 1: A sample grading interface in CMS. This view is referred to as the "grade sheet."

All our course lectures are available online as tutorials within CMS. An example of a typical tutorial found in CMS is shown in Figure 2. Our main goal is to introduce students to software packages and to demonstrate the usefulness of these tools in real-world applications. Due to obvious time constraints and complexity of the software packages introduced, we place emphasis on creating materials that provide students with a nice umbrella overview of the software capabilities. Thus this feature in CMS, aids in creating more specialized lectures for the course material covered rather than using generic textbook examples and eliminates the need for students to purchase additional course textbooks. From the instructor's aspect, it eliminates the need to copy and distribute supplemental materials. In addition, since all submissions made by students are done electronically, this assures that the course is paperless. This paperless studio assures that students have access to all materials needed for the course. The use of CMS to disseminate course materials also helps students who may need assistive services for special needs or for students who may miss a class.
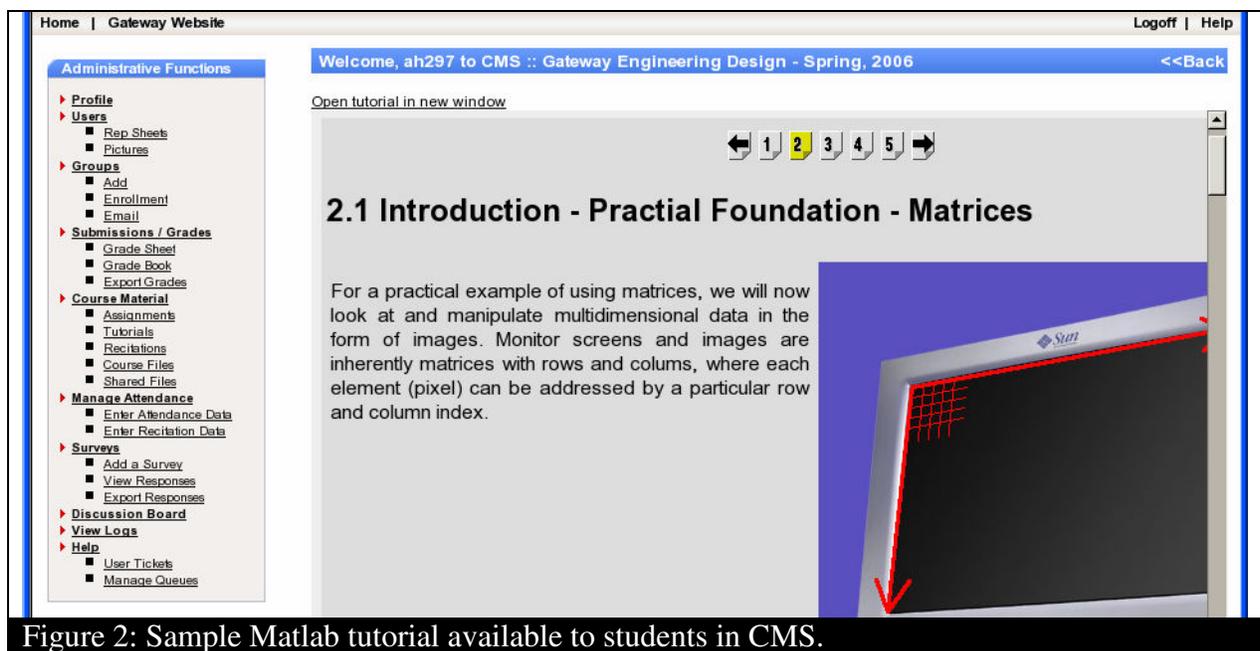

Figure 2: Sample Matlab tutorial available to students in CMS.

File sharing is an important aspect to this course since students working on projects in teams need an effective way to transfer files. For this reason, CMS allows for file sharing amongst students on a team along with emails to be sent within the system to one's own team. Also, since the files are posted for each student on the team to view, files can be easily modified and uploaded so that each team member is aware of the most recent version of their documents. The use of email as transfer means for such documents was tedious in the past. Institution enabled email quotas are often not enough for effective file transfer. Another benefit to this approach is that instructors can post supplemental materials online as well to aid students in their projects.

The multidimensional approach used to teach our course results in the creation of an instructional staff. Each person on the staff manages a different aspect of the course. Thus, many times when a student has a question or concern regarding the course, he/she is unaware of who the best contact person to handle the situation. For this reason, the help-ticket function was created in CMS. This allows for faster and more effective communication between students and the instructional staff.

Whenever a student has a problem, question, or concern to ask pertaining to the course or the project, he/she can fill out a help-ticket by logging into CMS as shown in Figure 3. The help-ticket asks for students to choose a category for their request (i.e. Grading, Assignment, Project, or Attendance), assign a title, and write a description of their issue. Once the student clicks "submit" the help-ticket is assigned a number and a copy is sent to the student as well as each of the instructional staff members. The ticket then appears on the administrative end of the website and the appropriate staff member can then respond by logging into CMS. When the staff member responds to the ticket, the ticket is marked as being closed and each staff member as well as the student is sent a copy of the response. Using this method, we were able to monitor that all requests were answered within 24 hours.
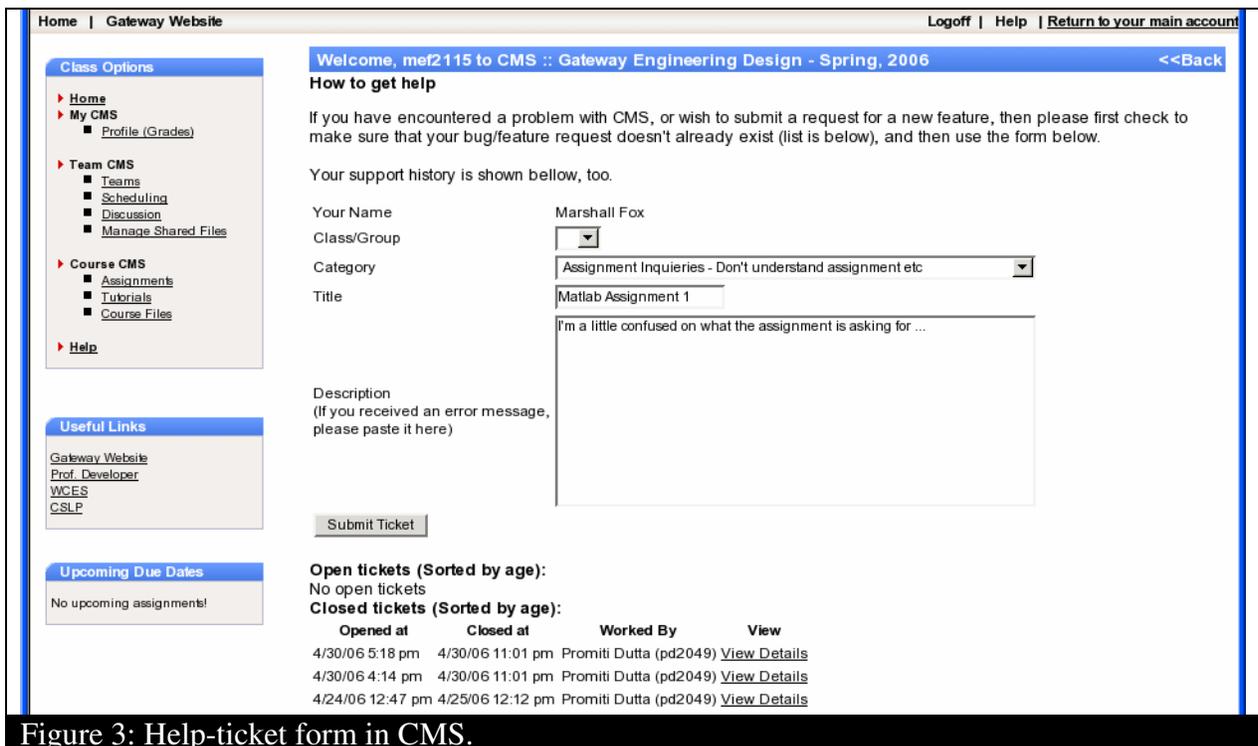
Figure 3: Help-ticket form in CMS.

A key feature that distinguishes CMS from existing web-based management systems is its built-in project management tools. This feature is extremely important to our students, as one of the course outcomes is to ensure that students learn the proper usage of such tools. While commercial software exist for this purpose, the use of such software involves a learning curve as well as added costs to purchase such software packages. Using CMS, students have the ability to generate Gantt-charts and task-lists without the need of any additional software packages. Also, since much of the course material and due dates are already on CMS, students can perform a direct import of important dates for their task list and Gantt chart. These project management tools are crucial to the success of our students in their project teams since the assigned community projects span the duration of the semester. Since each student also has a full course-load aside, it is critical to ensure that students are aware of the individual tasks that need to be completed for a successful project.

Coupled in with having tasks only associated to their projects and their community clients, students also have the responsibility to fulfill classroom assignments that relate to engineering design principles and software packages taught. To accomplish this effectively communicate deadlines for all assignments, CMS contains two views students can personalize to best meet their organizational needs: graphical monthly calendar view and weekly text list. Figure 4 shows a typical student calendar view. All class assignments and tutorials are available on the calendar as links so students can easily navigate to the pertinent information.
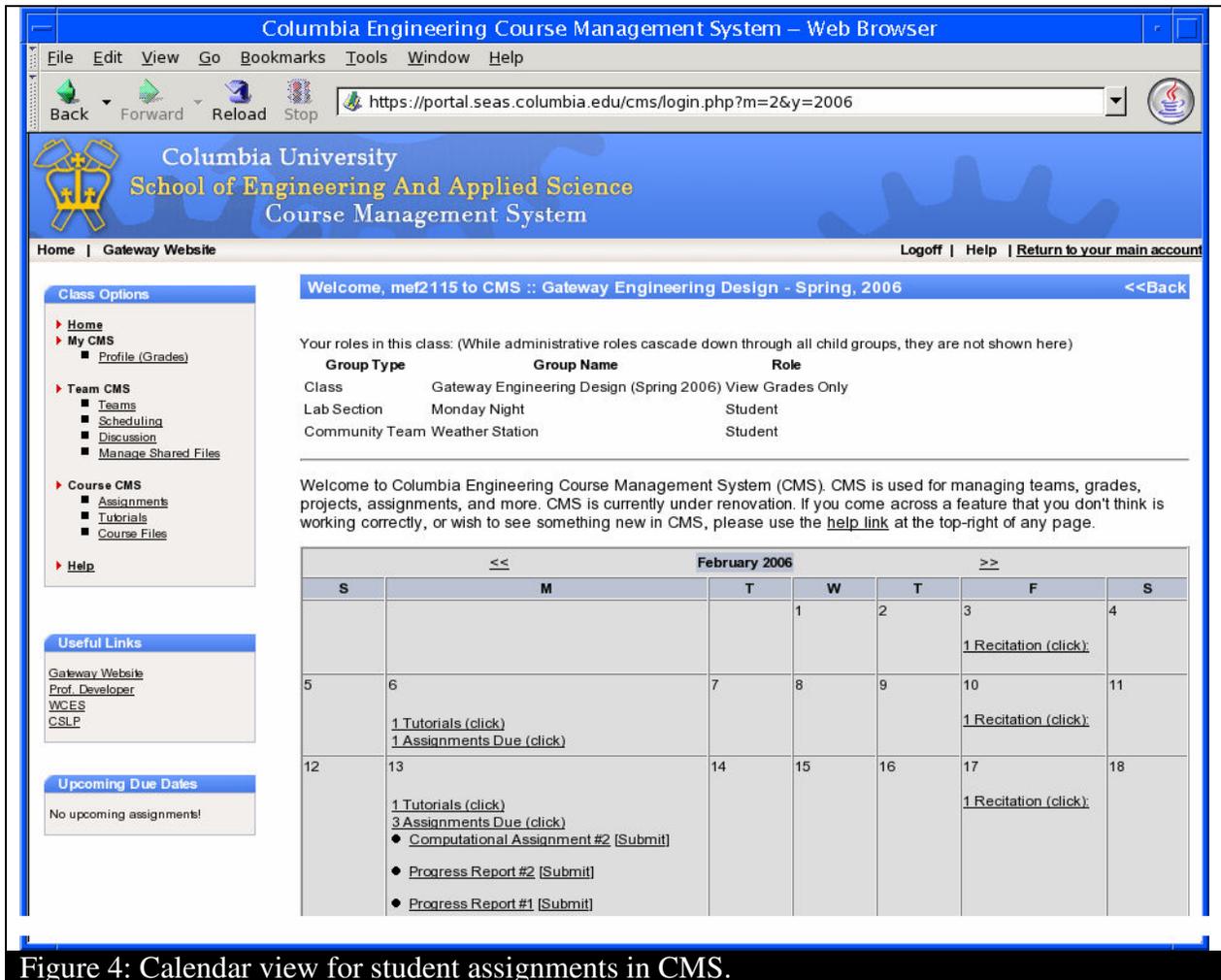

Figure 4: Calendar view for student assignments in CMS.

Another key feature, the student report sheets allows for students and instructors to constantly monitor academic progress in the course. Each students report sheet contains a student profile picture, attendance records, and grades for individual and group assignments. The real-time feedback that this allows is of great help to students in determining their progress in the course and areas of weakness as shown in Figure 5.

Figure 5: A sample student report sheet as seen by instructors and the student.
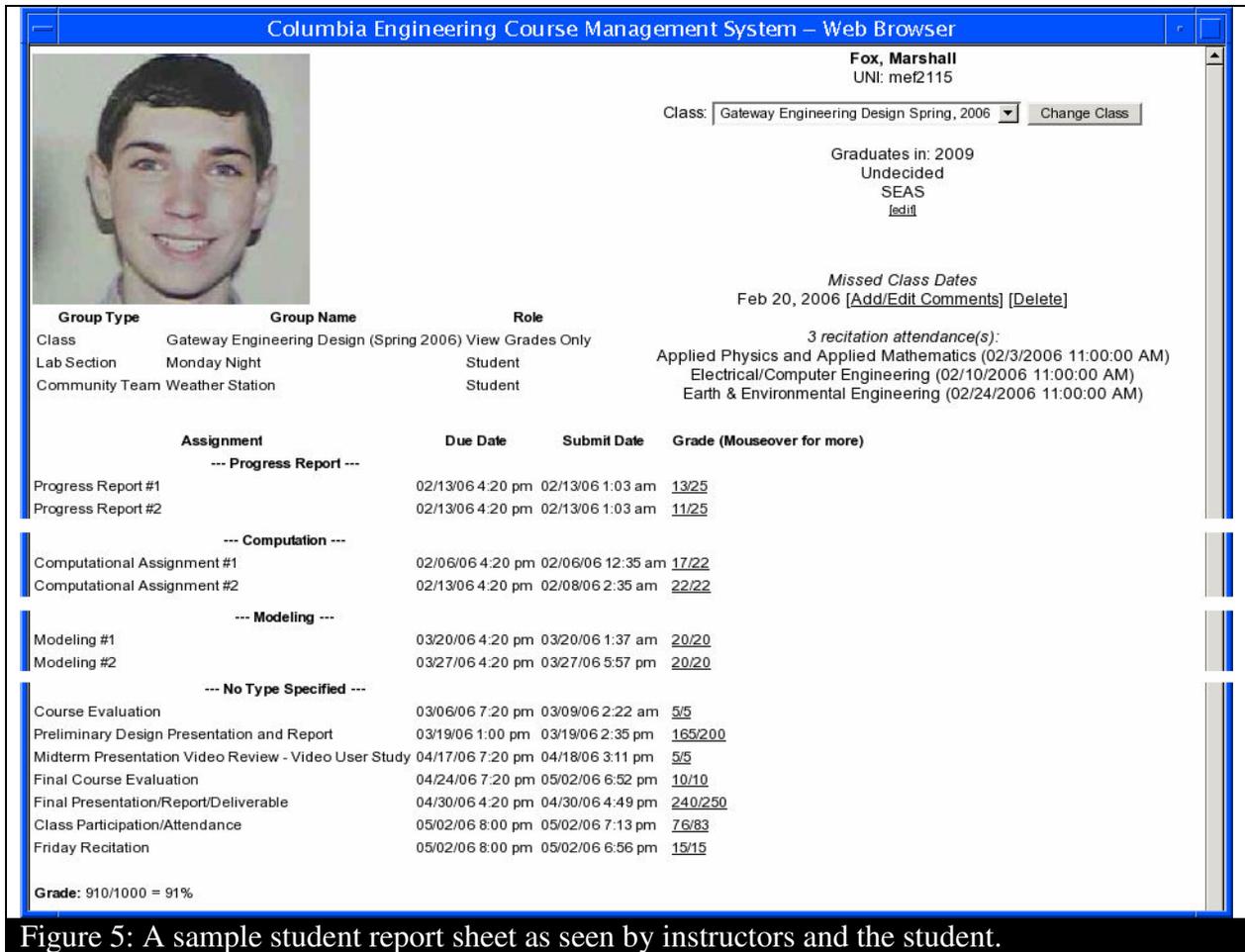
While other course management systems already exist in the commercial market, such as Blackboard and Courseworks, we have yet to find one that facilitates both group and individual aspect of a course. The most important aspect missing from the already available commercial systems is the group feature for collecting assignments and disseminating appropriate course materials. Since our course is very multidimensional and multimodal, we have the need to create a versatile tool to easily address all our needs.

Project Archival Tool (PAT):

While the concept of using a database driven system to archive past projects may not seem like a novel concept, very few websites exists that coherently and conveniently present student work. PAT is a database-driven organizational website especially useful in collecting, organizing, and disseminating information to clients and students about the project status and completion. Figure 6 shows a screenshot of the initial screen that visitors are welcomed to.

Figure 6: Screenshot of PAT homepage.

A fundamental step in successfully completing an engineering design project is to conduct effective data gathering and background research. A student team must understand what currently exists or what has been done before to make informed decisions about the direction of the project assigned. According to the "Checklist for an Informational Web Page" created by Jan Alexander and Marsha Ann Tate[1], there are certain criterion that determine the validity of an informational web page. Important considerations are as follows: authority, accuracy, objectivity, currency, and coverage. PAT meets these requirements for each criterion listed. This makes PAT an appropriate tool for students to use for their background research and data acquisition.

To assist in the dissemination of resources for students and community partners, each project listed in PAT has its own page with the following information: title of project, project type (genre), term in which project was completed, description of project goals, listing of community partner, students and advisor involved in project, continuity projects, report and presentation archive files, and additional images relating to the project. Figure 7 shows an example of a project report sheet. Since projects can be categorized by genre, term of completion, and community partner/client, these exist as links from each project report sheet. The main purpose of these links is to ensure that a user of the website can maneuver to find similar projects easily. Links also exist for each student and advisor to see other projects that these individuals may have taken part in. The linking of projects between terms is an extremely important field of the project report sheet for project spanning multiple terms. This allows for the user to see the progress and evolution of each project chronologically. The report and presentation archive files along with additional images are imperative documentation that provides essential information for community partners and students assigned the continuation of a project.

Figure 7: Report sheet available on PAT for the Wheelchair Swing project completed in Spring 2006.

Searching for a past project is made simple by multiple methods. A user can search for a project by term, genre or using a search function. This eliminates the unnecessary hassle of using the toolbars to find the necessary information. The search function allows for a user to search using keywords for a community partner or project name. It also allows for the user to search by student name if the user is looking for a specific student's work done while in the course.

A very common problem encountered before the creation of PAT was the effective transmission of all completed project materials to community clients and to future students working on the continuation of the project. PAT greatly simplifies this process since all materials are updated and uploaded to the website upon the completion of an academic term. This ensures that the following term's students have ready access to all-important files. Community partners find great use to share these materials with their colleagues and perspective organizations in pursuing the implementation of proposed design ideas by the students. The ease of using PAT as the main source of transmittal for such relevant documentation helps the workload for the course staff.

Conclusion:

CMS and PAT have become integral parts of our engineering design course. Current students appreciate the ease of use while former students enjoy the benefits of having their work archived and published on the web. Surveys conducted to obtain feedback from students and community partners demonstrate positive responses. Students find CMS easy to use with a small learning curve. Therefore, they are able to benefit from the plethora of resources and assistance CMS can provide during the academic term. The help-ticket function of CMS received mixed reviews. While some students find tickets to be helpful especially because of the rapid response rate and turn around time, many feel that the use of tickets removes the instructor-student relationship. These students complain that the use of help-tickets is impersonal and lacks human interaction.

Community partners do not use CMS, but are heavily reliant on PAT. Since all the project materials collected each term are placed on PAT, this resource is invaluable to any current and future partner. Partner remarks on the survey indicate satisfaction with the ease of use, structure, and design of the website. Our site statistics show heavy traffic from visitors outside of our institution. This indicates that the site is a resource for our community clients as well as other institutions, students, and organizations working on similar projects.

Future work to improve CMS and PAT are underway. We would like to have more project management tools available for our students on CMS. These include the creation of objective trees, list generators for functional requirements and design constraints, action priority matrices, etc. Our goal is to device an easy method to transfer pertinent information regarding the projects between the two systems to reduce the amount of manual work required to update PAT.

Acknowledgments:

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