A Web Portal for Capstone Project Planning and Archival

By

Nermin Kadric and Edward Kolis

Submitted to
the Faculty of the Information Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Engineering Technology

University of Cincinnati
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Nermin Kadric	Date
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Edward Kolis	Date
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Hazem Said, Ph.D. Department Head and Faculty Advisor	Date

Acknowledgements

We wish to acknowledge the following for their contributions to our project: Anthony Ricciardi of the UC Foundation, for providing us with the idea for the project; Dr. Hazem Said, for keeping us on track with weekly advisor meetings; and Conrad Kolis, for guiding Ed toward the light at the end of the year-long tunnel.

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Abstract

At the College of Applied Science, students in various disciplines are required over the course of their senior year to develop “capstone” or “senior design” projects. Students often have trouble finding suitable projects, despite the wealth of possibilities that could be developed into projects which would be beneficial to companies, schools, or individuals. Our project, *A Web Portal for Capstone Project Planning and Archival*, solves this problem by providing a Web interface for potential project sponsors to submit project ideas and students to express interest in them, all under the guidance of faculty advisors. It also facilitates business networking between project sponsors (who may be looking for new hires) and senior-level students (who may be looking for jobs once they graduate), and it provides additional recognition for those individuals and organizations involved with exceptional completed projects.

A Web Portal for Capstone Project Planning and Archival

1. Statement of the Problem

The College of Applied Science (CAS) has a variety of degree programs, ranging from Information Technology to Construction Management. At least five of these programs require capstone projects which are presented at the annual Tech Expo (7).

What is currently lacking at CAS is a unified system for organizing these capstone projects – that is, a way to get the projects from the "wouldn't it be nice if someone could solve this problem" stage to the "we have a student or project team ready to tackle it" stage. As we have found through our own experiences in Senior Design I, the current methods for identifying potential projects and organizing seniors to work on them are rather ad hoc: the Senior Design instructor may post a potential project on the Blackboard course-management site, or someone may approach a student privately with a project idea, or a student may come up with a project idea on his or her own. This can leave some students in the dark if they are not initially successful at latching on to a project. In addition, methods may vary from one degree program to another.

Another item lacking is an easy, automatic method to showcase the best projects from past years. The current Tech Expo Web site is a single manually created page providing a paragraph of information on the most recent Best of Tech Expo winner and listing the various award winners in each degree program (7). There are no details for projects other than the most recent Best of Tech Expo winner, and the level of detail there is sparse. Improving the amount of detail provided on the Web site and making that information more easily available would provide several benefits:

- Improving the way the college is advertised to prospective students

- Improving the image of the college as presented to prospective employers of graduates from the programs
- Providing better recognition to students who worked so hard to earn the Tech Expo awards

2. Description of the Solution

We have provided a potential solution in the form of a Web portal which companies and organizations can use to submit project ideas, seniors can use to latch on to projects, and anyone with an interest in the college can use to browse through completed projects. This portal is role-based, being accessible to four types of authenticated users as well as the general public, with different functionality for each role.

2.1. User Profiles

2.1.1. Project Sponsors

These are people of various backgrounds – corporate representatives, faculty members, or simply private individuals – who are united in the fact that they all have a problem they need solved. Their main concerns are submitting their potential projects, communicating with the students working on the projects once they are committed to working on them, and ensuring that they are recognized for their ideas and support.

2.1.2. Graduating Seniors

These are upper-level students in various disciplines at CAS. They have varying levels of Internet savvy, probably ranging from intermediate to expert, and are typically in their early 20s. Their main concerns are finding a suitable project to work on and communicating effectively with their advisors, sponsors, and any teammates.

2.1.3. Faculty Advisors

These are experienced faculty in various disciplines at CAS. They have varying levels of Internet savvy, probably ranging across the spectrum, and are of varying age groups, but tend to be older than seniors. Their main concerns are ensuring that projects

that are submitted are suitable for seniors to work on and communicating with the students they are advising.

2.1.4. Web Portal Administrators

These users will consist of faculty, university staff, student workers, or a combination of the three. Thus this user profile is basically a mix of the “advisor” and “senior” profiles, but with the provision that all users in this role will have high levels of computer savvy. Since users in this profile are not necessarily faculty, it is important to make this a separate profile so that non-faculty administrators do not have the ability, for instance, to approve projects. Administrators’ main concern is making sure that all users have access to the information they need, and at the same time have access to no other information besides what they need.

2.2. Design Protocols

The use case diagram (Figure 1) shows the main scenarios of use for each of the user profiles. As the diagram shows, non-authenticated users (the general public) have very limited functionality. However, potential sponsors are able to register their own accounts, which grants them the ability to submit projects for approval by faculty advisors. Should this ability be abused, administrators will be able to disable the offending user’s account. Also of note is the fact that since administrators are not necessarily advisors, sponsors, or seniors, they do not automatically have full access to all use cases. However, since any administrator can grant himself or herself access simply by adding himself or herself to the appropriate role, that precaution is more of a convenience to avoid cluttering up the user interface than an actual safeguard.

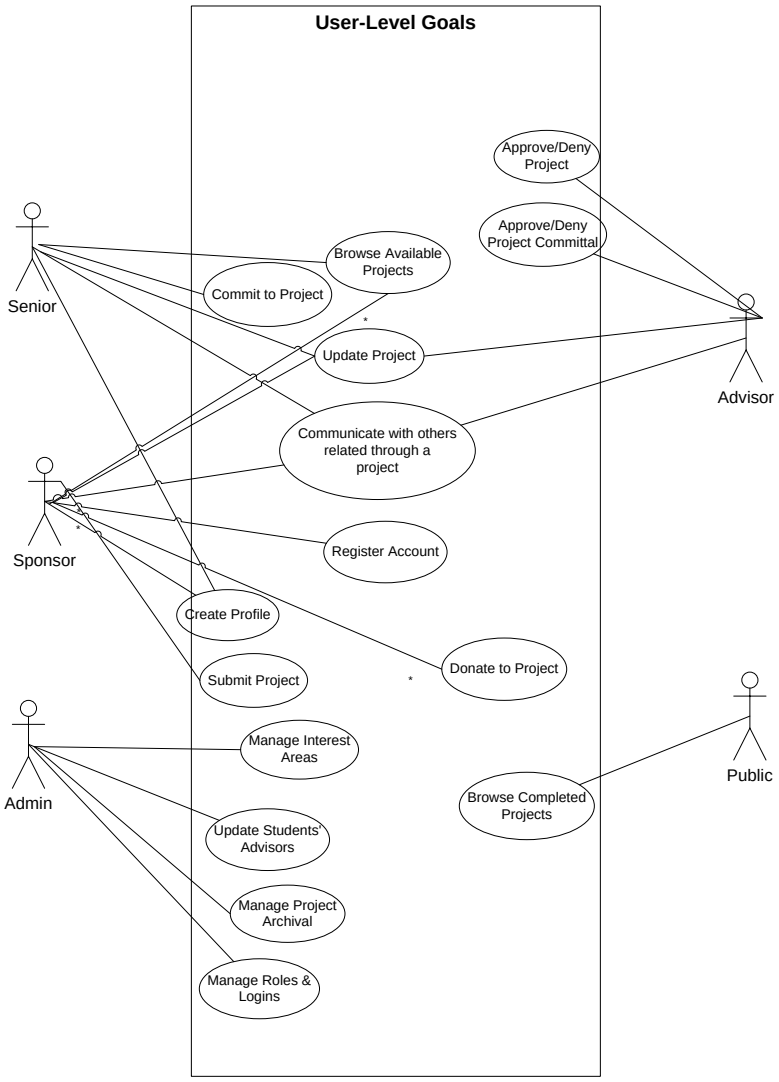


Figure 1. Use Case Diagram

The database diagram (Figure 2) shows the overall structure of our database. The diagram centers around the Projects table (upper center) and the Users table (lower center). The Projects table contains information about projects at all stages of their life cycle – titles, descriptions, statuses, and so forth. The Users table contains information about users of the system – names, addresses, passwords, and so forth. The passwords are encrypted so that even if the database is compromised, the passwords cannot be easily

retrieved. For each role that a user belongs to (advisor, senior, sponsor, or administrator), there is also an entry for that user in the appropriate role table. Also of note is the InterestAreas table; the self join (represented by a loop in the diagram) is present so that areas of interest for users or projects can be grouped hierarchically.

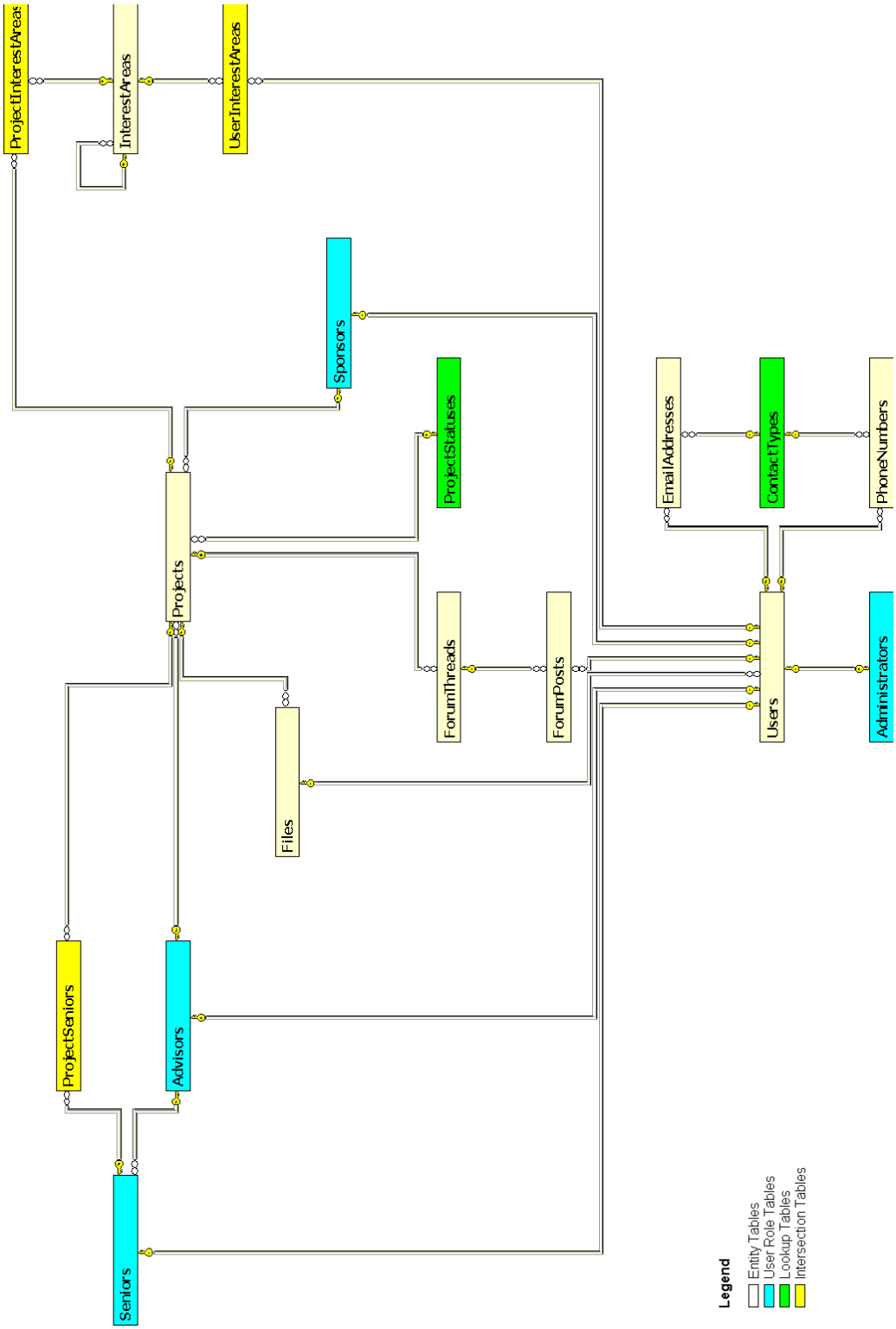


Figure 2. Database Diagram

3. Deliverables

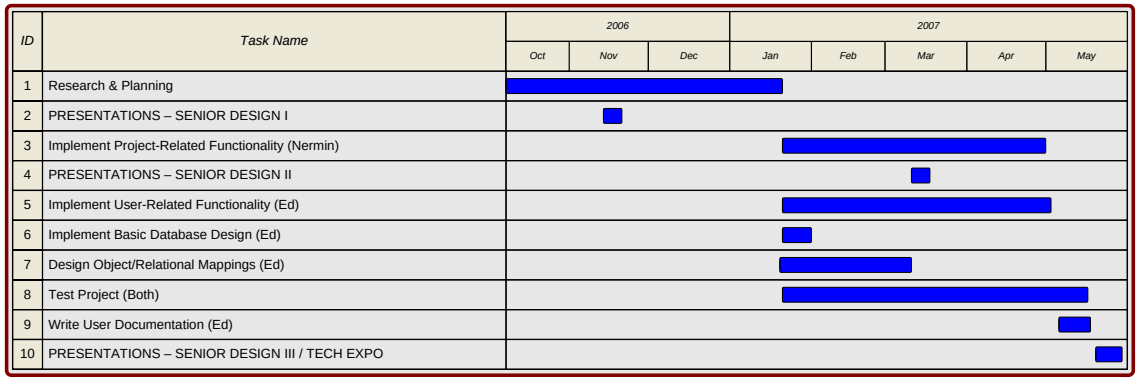
The deliverables for our project consist of the following:

- An ASP.NET / C# 2.0 Web portal with the following functionality:
    - Seniors can create profiles, browse available projects, commit to available projects, update their committed projects, and communicate with others related through a project.
    - Project sponsors can register accounts, create profiles, submit new projects, browse available projects, donate to a project, update their existing projects, and communicate with others related through a project.
    - Advisors can approve or deny projects, approve or deny students' committal to projects, update their existing projects, and communicate with others related through a project.
    - Administrators can manage roles and logins, manage user/project interest areas, update students' advisors, and manage existing projects in all stages of their life cycle.
    - The public can browse completed projects.
- Documentation explaining how to use and administer the Web portal

4. Design and Development

4.1. Timeline

The timeline (Figure 3) illustrates the time each team member has spent on the project. We spent the autumn quarter and the first week or so of the winter quarter doing research and planning. In November we presented our proposal in front of the advisors and class. Then, starting in January, Nermin began working on the core project-related functionality, and Ed began working on the database design, user-related functionality, and object/relational mappings necessary for the application to interact with the database. Throughout development we both tested the project (see section 6, “Testing”). In March we presented a prototype to the advisors and class, and in May Ed wrote the on-line end-user documentation. Finally, we have presented at Tech Expo on May 16, and we will be presenting our final demonstration in front of the advisors, the class, and anyone they might invite on May 31.



Use Cases by Task

Project Related Functionality
Submit Project
Approve/Deny Project
Browse Available Projects
Commit to Project
Approve/Deny Project Committal
Update Project Status
Browse Completed Projects

User Related Functionality
Register Account
Create Profile
Manage Roles & Logins
Manage Interest Areas
Communicate with Related Users

Figure 3. Timeline

4.2. Resources

We have used the following resources:

- Labor – We are working on the project in what time we have outside of school and work. In addition, our academic advisor, Dr. Said, has provided us with assistance, and Jason Kumpf has helped out with the importing of senior user accounts from the enrollment database (though due to technical issues we were unable to use what he had provided). Also, were this solution to be actually implemented, there would be the requirement of having someone to fill the system administrator role.
- DIT-SENIOR Web/Database Server – This is the server on which our project has been running during its development.

- Network Connection – We need a connection to the Internet and a URL (Uniform Resource Locator) in order for our application to be accessible.
- Deployment Server – Were we to deploy the project, we would need a server provided by the university for this purpose.
- Three copies of Microsoft SQL Server database management system – DIT-SENIOR is running SQL Server 2000; however, when we deploy the project, the final server should be running SQL Server 2005 Standard or Enterprise Edition, though SQL Server 2000 would be sufficient. For the development PCs, we are using SQL Server 2005 Standard Edition because that is what is available through MSDNAA (Microsoft Developers' Network Academic Alliance) (4), but SQL Server Developer Edition would suffice.
- Windows Server 2003 operating system – This project is capable of running on Windows XP Professional as well, but the university currently uses Windows Server 2003.
- Two development PCs (one for each team member) – We have these at home.
- Two copies of Windows XP Professional (one for each team member) – These are needed for running Visual Studio 2005. Windows XP Home would suffice, however.
- Two copies of Microsoft Visual Studio 2005 integrated development environment – We are using this software for the actual development of the application.
- NHibernate object/relational mapping software – We are using this software library as a data access layer in our application.

4.3. Budget

The budget (Figure 4) shows our cost for this project. The total cost were we doing this “from scratch” with no preexisting resources would be approximately $12,000 for materials (the labor costs would be too difficult to estimate), but with what is provided for us by the College of Applied Science and what we have already on hand there is no direct monetary cost save for the time of the system administrators. Note that we are using MSDNAA (Microsoft Developers’ Network Academic Alliance) software only on the development machines, not on the deployment machines, in accordance with MSDNAA licensing which permits usage of the software for educational but not for infrastructure purposes (4).

Item	Retail Cost	Our Cost	Notes
Web Server	$800.00	$0	Provided by CAS; cost estimated for sufficiently powered machine
Web Domain Subscription - 5 yrs	$175.00	$0	Provided by UC
SQL Server 2005 Standard	$5,999.00 (1)	$0	Provided by CAS; using SQL Server 2000 during development since 2005 is not yet on server
Windows Server 2003	$1,209.00 (3)	$0	Provided by CAS
Development PC x2	$1,200.00	$0	Already have; cost estimated for sufficiently powered machines
Windows XP Pro x2	$539.98	$0	Provided by MSDNAA
SQL Server 2005 Developer x2	$98.00 (1)	$0	Using Standard edition provided by MSDNAA but Developer edition would suffice
Visual Studio 2005 x2	$1,598.00 (2)	$0	Provided by MSDNAA
NHibernate	$0.00 (5)	$0	Free of charge under Lesser General Public License
Total Cost (excluding sales tax and maintenance)	**$11,618.98**	**$0**	Sales tax will depend on where items are purchased. Maintenance requires knowledge of various CAS employees' salaries to estimate.

Figure 4. Budget

5. Proof of Design

5.1. Project Life Cycle

5.1.1. Submission for Review

Anyone can submit an idea for a project; we call people interested in doing so "project sponsors." We created a wizard to add a new project idea. (See Figure 5) This wizard helps the sponsor enter a project idea through a few steps: title, areas of interest, description, and provided funding. Once all the information is entered, the sponsor can view a summary, and correct it if something is wrong. After an idea is submitted, it will be available for a faculty review so they can take appropriate steps. This project idea is editable until the status is changed. Every new project idea has a status "New" until it is reviewed by the faculty.

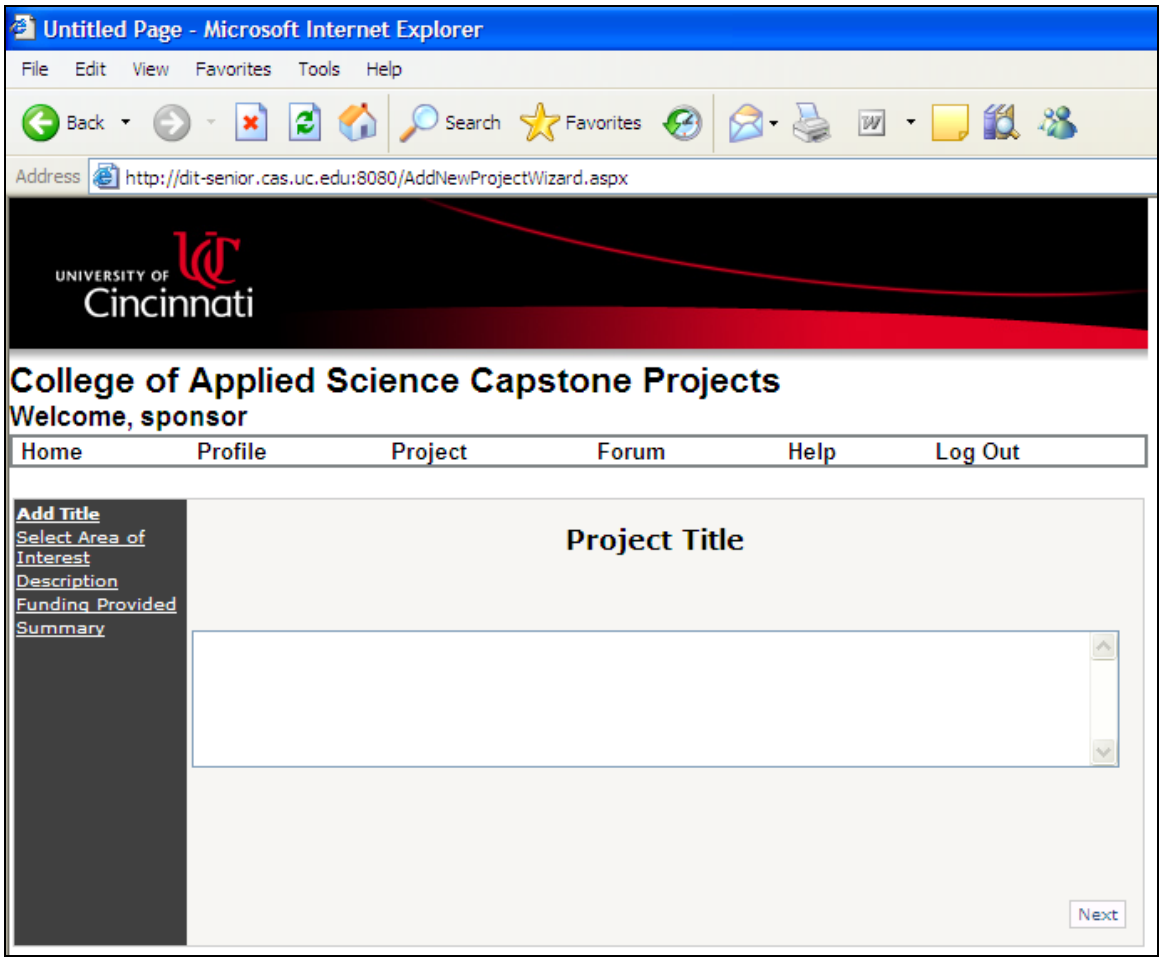


Figure 5. Project Submission for Review

5.1.2. Faculty Review

Faculty members or "advisors" can browse projects under the "Browse Projects' section, and filer projects by the different statuses (see Figure 6). Advisors can review new entered projects, and if the project satisfies their criteria for an acceptable senior design project, it can be approved, meaning this project will be available for senior students' browsing. If the new project does not satisfy requirements, faculty can disapprove the project and it will not be available for senior students' browsing. Faculty can change the project status any time they want (see Figure 7).

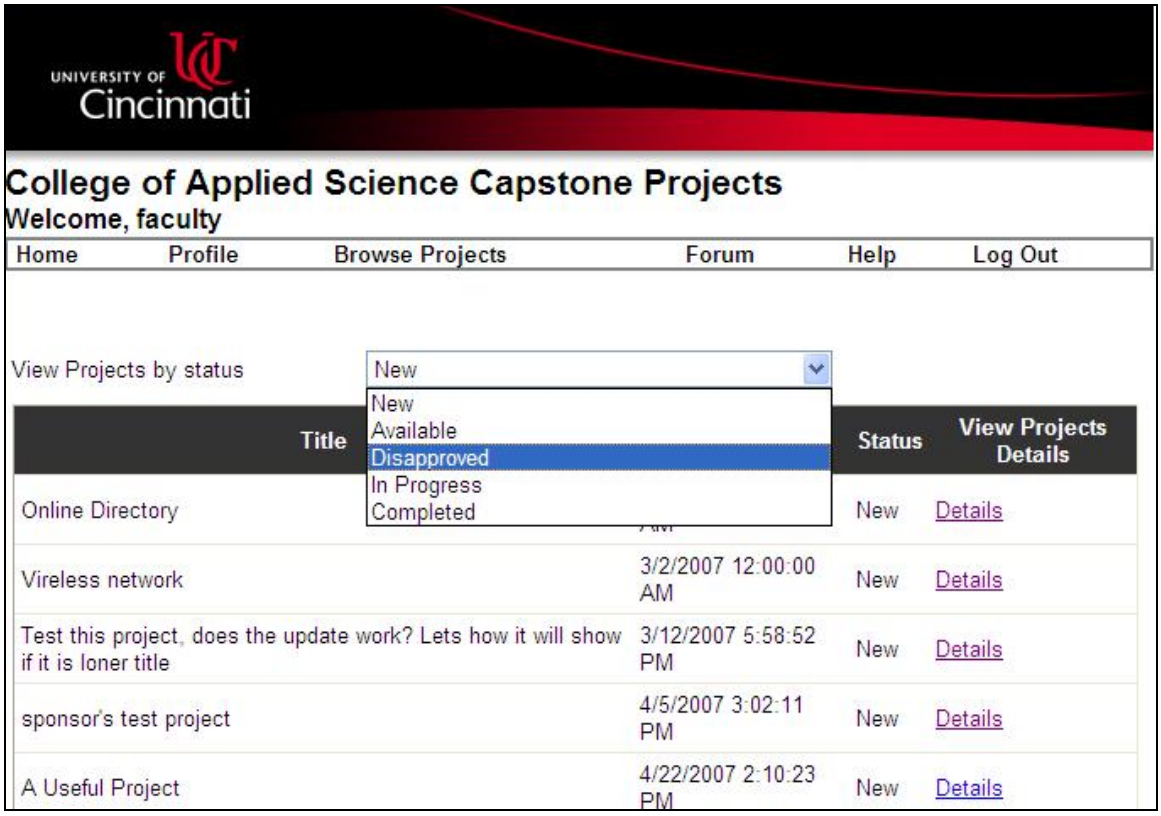


Figure 6. Faculty Review – Projects by Status

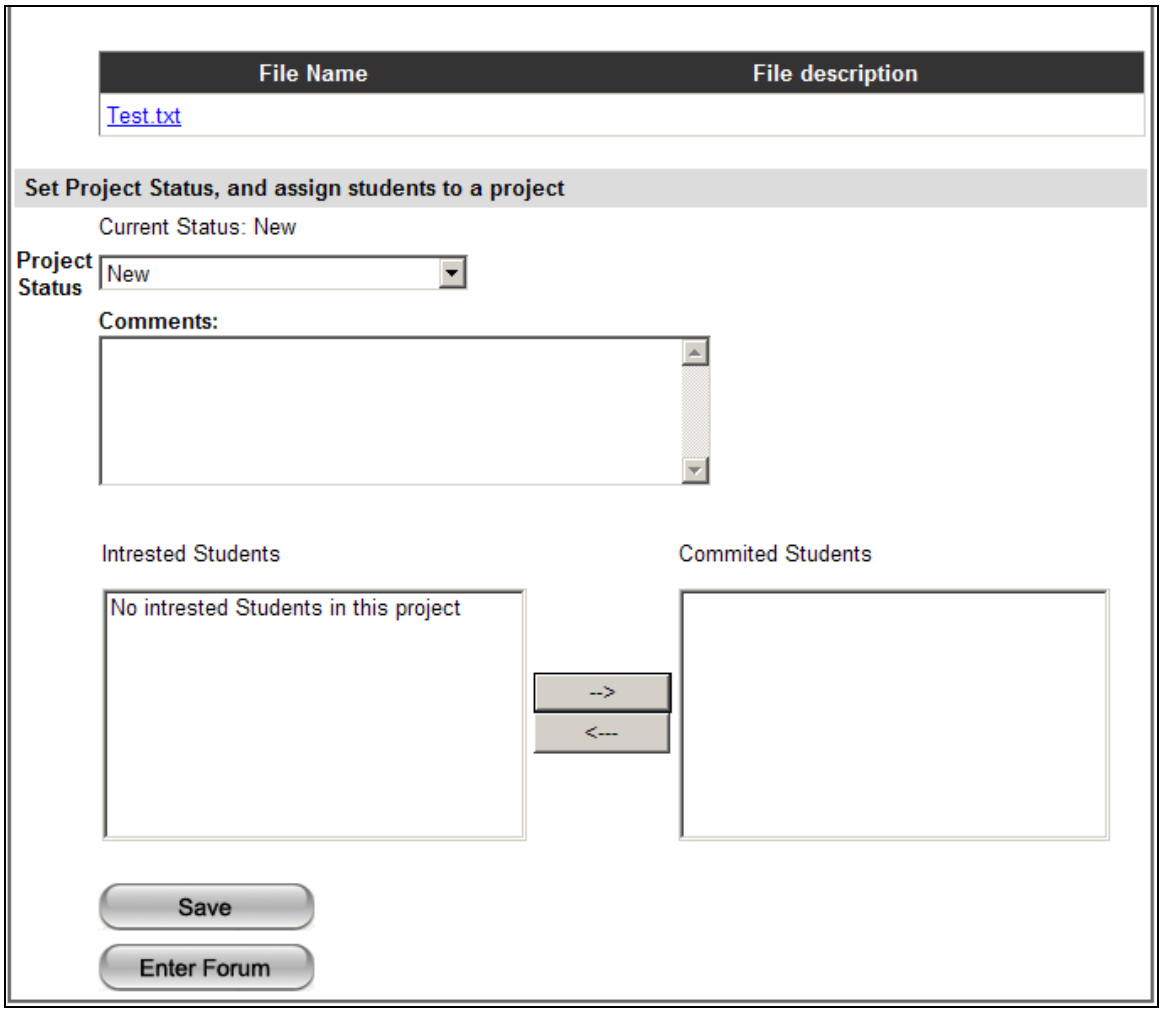


Figure 7. Faculty Review – Assigning Seniors

5.1.3. Discovery by Seniors

Senior students can search or browse approved projects. Under the “Project” menu, seniors can select “Search Projects” or “Browse Projects”. The Search Projects page allows students to search projects by specific keywords, or use the advanced search to narrow down their search criteria (see Figure 8). Browse page allows them to browse all available projects and view their committed/interest projects (see Figure 9). Senior students can click on project details to view all project details.

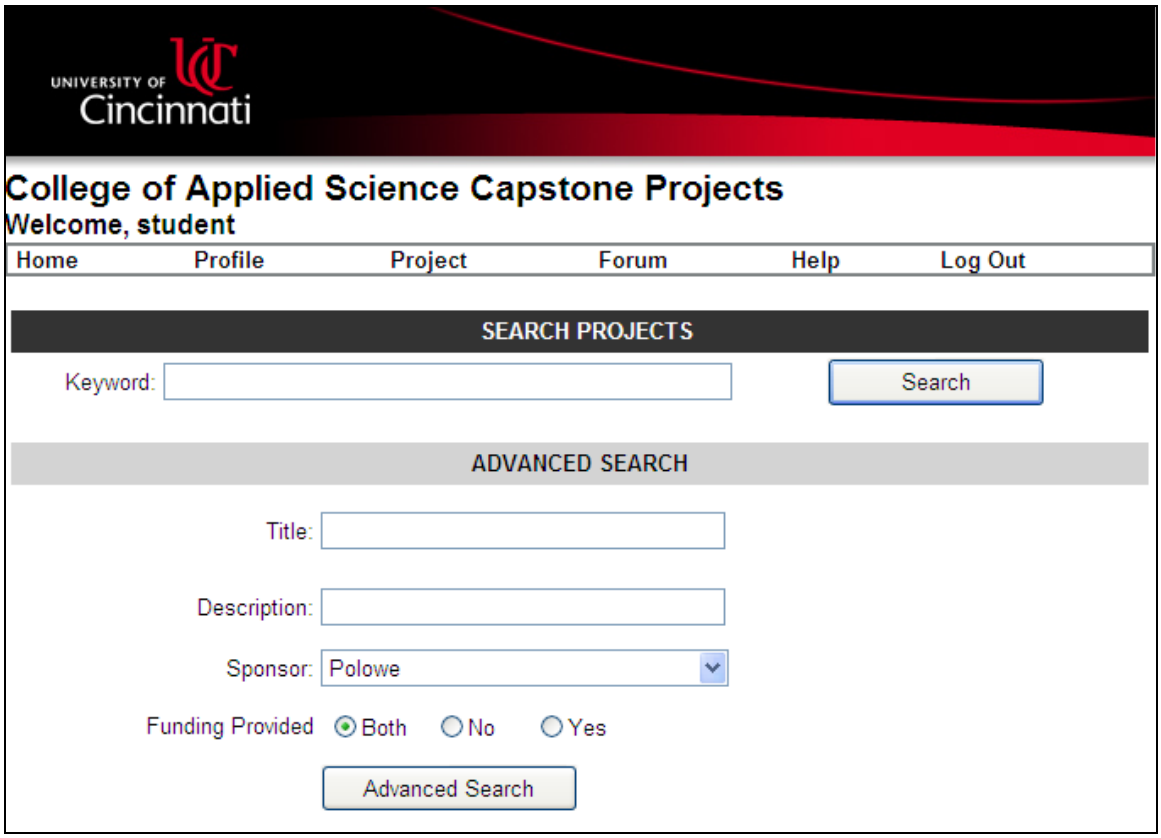


Figure 8. Searching Projects

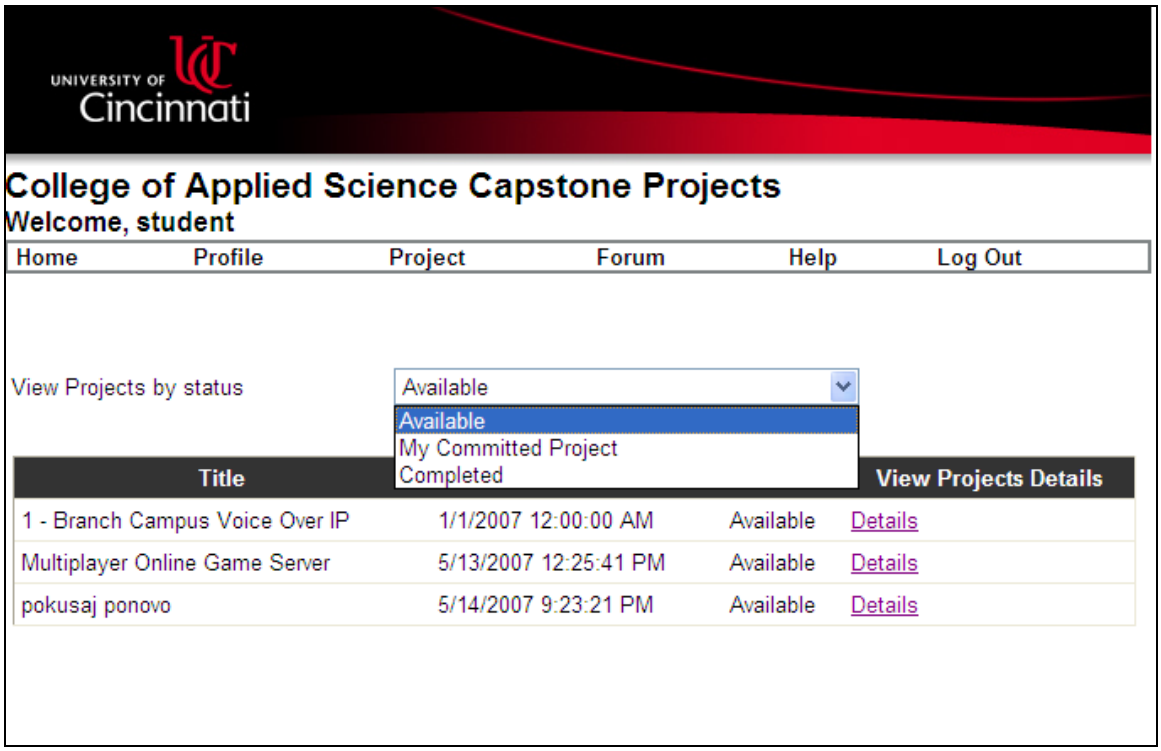


Figure 9. Browsing Projects

5.1.4. Senior Commitment

For seniors to be committed to the project, their commitment needs to be approved by the faculty. On the project details page, there will be available buttons for show and remove interest (see Figure 10). After he or she shows interest in a project, a faculty advisor for that project can commit student(s). (see Figure 7). After a senior is committed, he/she can take on the project and provide the solution for a given project requirements.

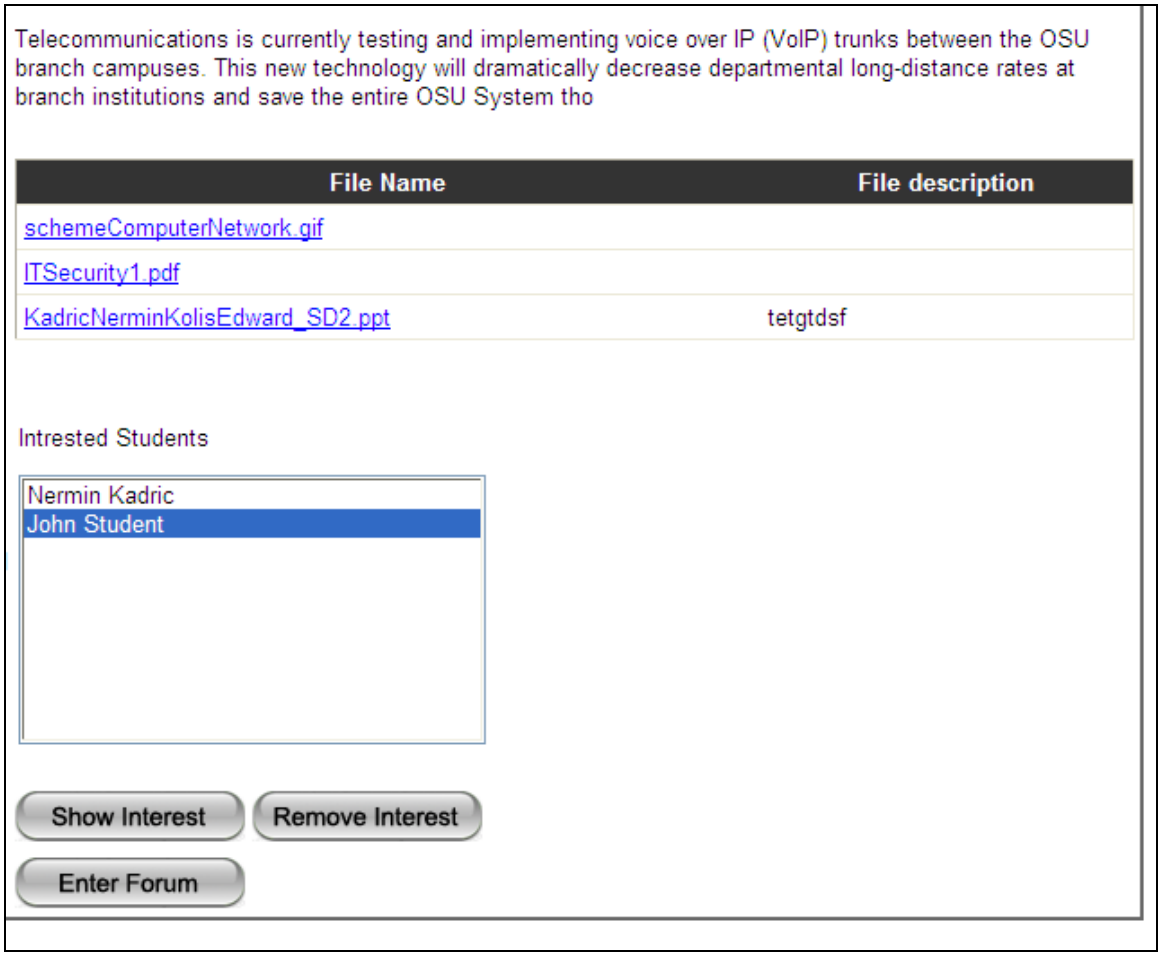


Figure 10. Project Details Page for Seniors

5.1.5. Forum Discussion

Each project has its own discussion forum, accessible to everyone who is involved in the given project in some capacity, as well as to portal administrators. In addition, there is an open forum for general discussion not related to any project; the open forum is accessible to anyone who is logged in. Clicking the "Forum" option on the menu bar brings up a list of forums accessible to current user. Each forum has a list of threads, available for discussion between project sponsors, advisors, and seniors (see Figure 11).

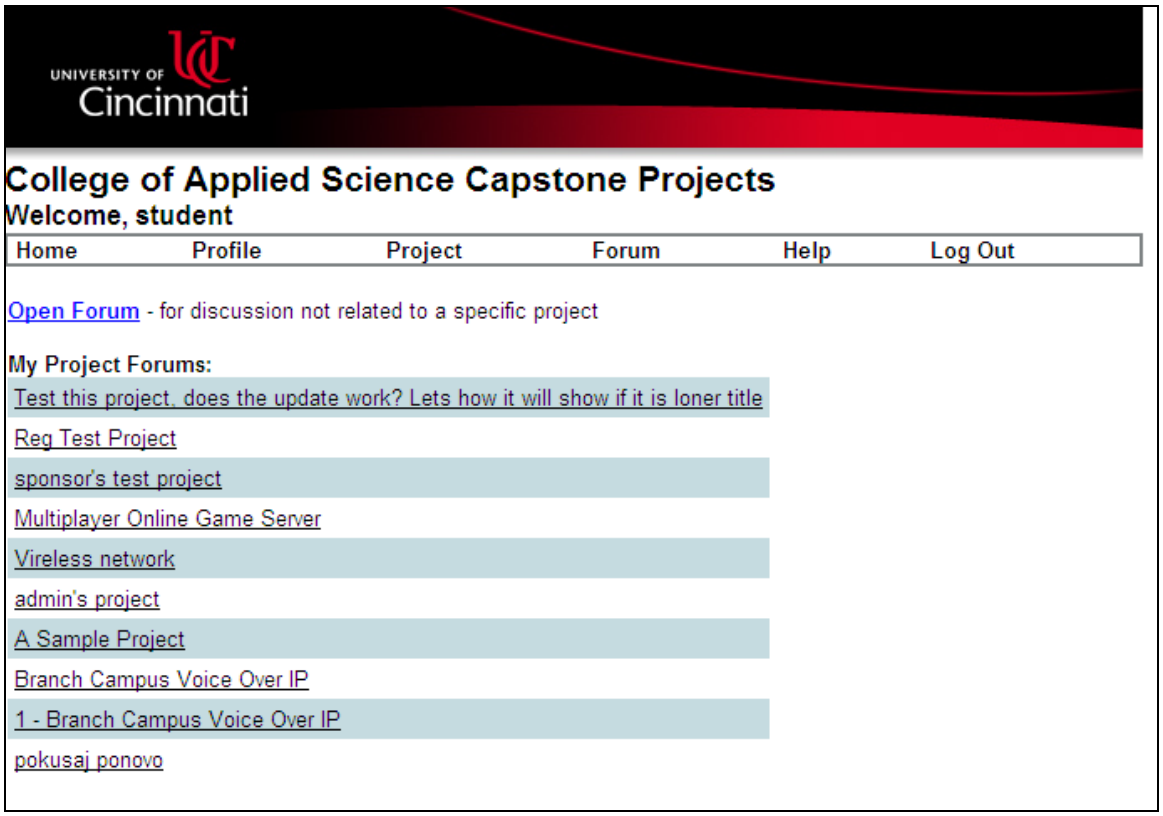


Figure 11. Forum Discussion

5.1.6. Archival and Publication

When a senior completes a project, the project advisor can change the project status to complete. Now this project is available for browsing by anyone, including guests. Guests can browse completed projects without logging in.

5.2. User Accounts and Administration

5.2.1. User Login, Registration, and Profile Editing

Every user must log in with his or her username and password (see Figure 12). If any user wishes to be a project sponsor, he/she can create a sponsor account (see Figure 13). (Senior accounts can be imported “en masse” from a CSV (comma-separated values) file, while faculty accounts must be created individually; both of these types of accounts can only be created by an administrator.) Every user should fill out his or her profile information, and every senior should specify his or her areas of interest in order to be able to browse projects that correspond to the same field of study. User accounts are authenticated from the database, and passwords are encrypted in the database so as to reduce the impact of any compromise of security.

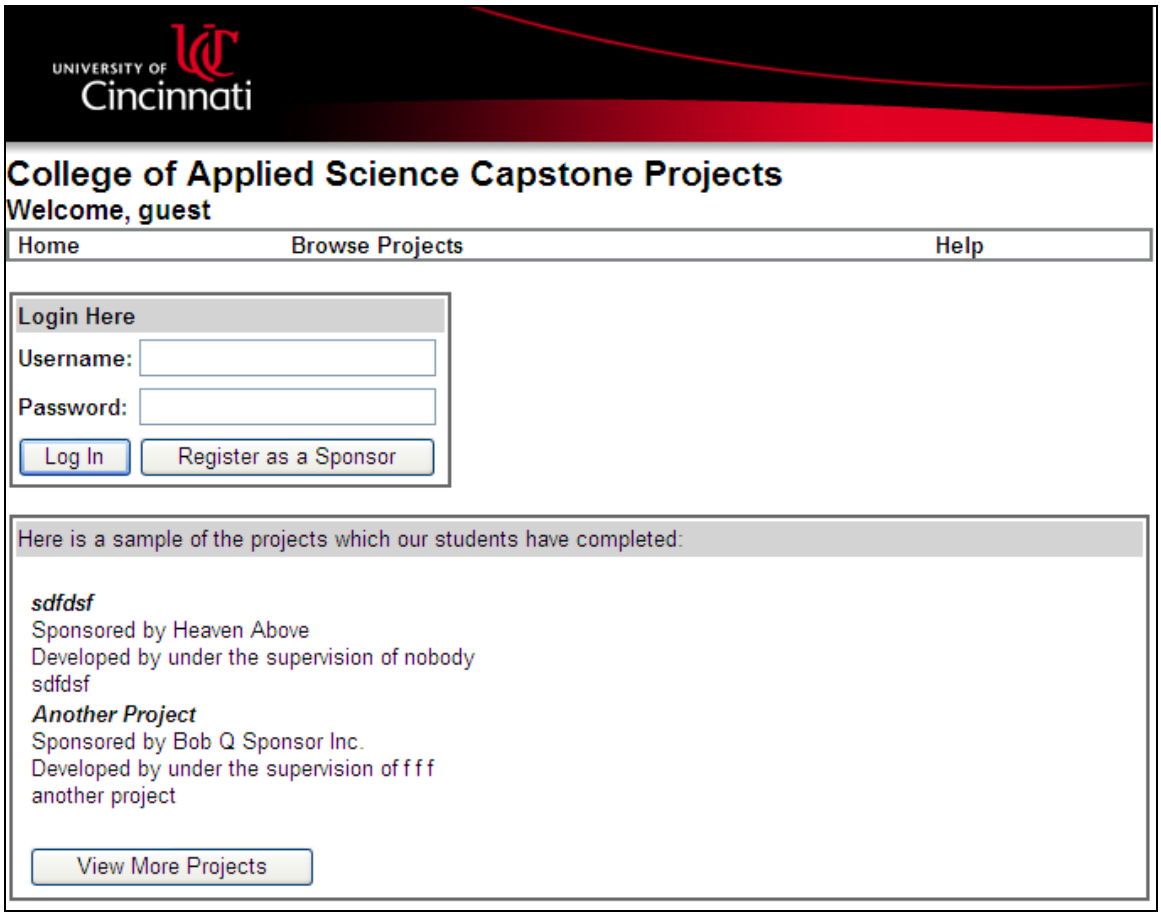


Figure 12. Home Page for Guest Users

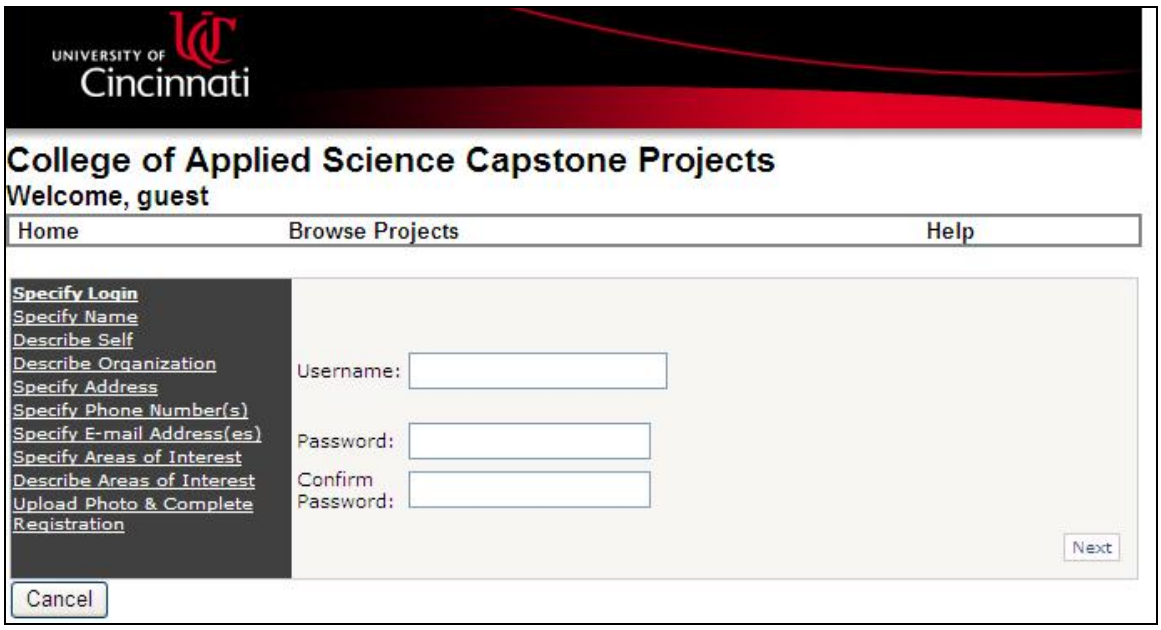


Figure 13. Sponsor Registration

Users who do not have an account (“guests”) can only browse completed senior design projects. They can browse projects by using the "Browse Project" option on the menu bar. Then they will be able to browse the projects that are completed, and they can view details of a project by clicking its "Details" link. Users can access in the Web Portal only what their user role(s) allow. The main menu and content pages are dynamic and will be different for every role.

5.2.2. Senior Importing

Web portal administrators may import senior accounts “en masse” from a CSV (comma-separated values) file, as shown in Figure 14, by selecting “Import Seniors from Enrollment” from the Administration menu. There are five required fields, but the administrator may choose to rename the fields if they are named differently in the CSV file. The imported users are expected to fill in the rest of their profiles when they first log in.

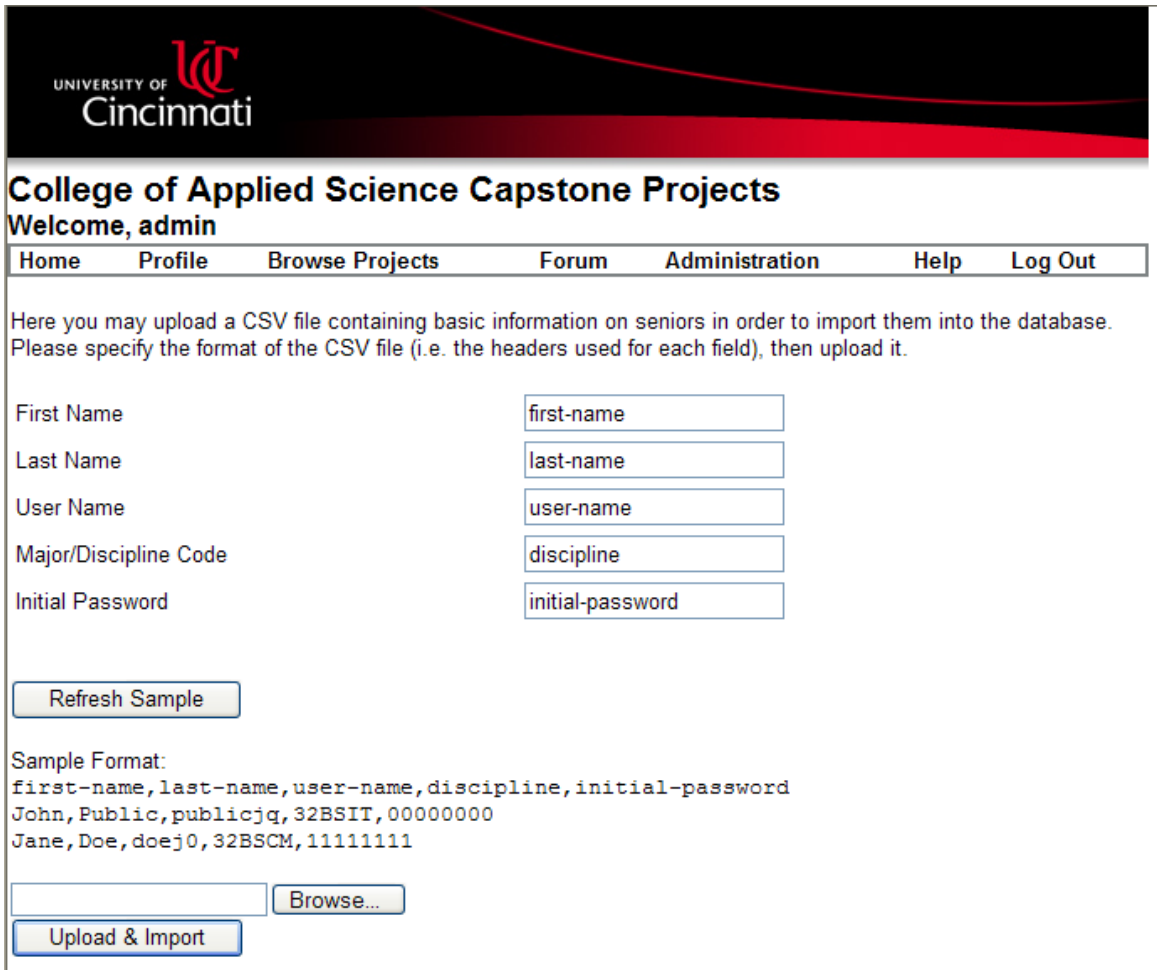


Figure 14. Senior Importing

5.2.3. Manual Account Creation

Administrators may also manually create accounts for any type of user by selecting “Add New User” from the Administration menu (see Figure 15). Again, newly created users are expected to fill out their full profiles once they log in.

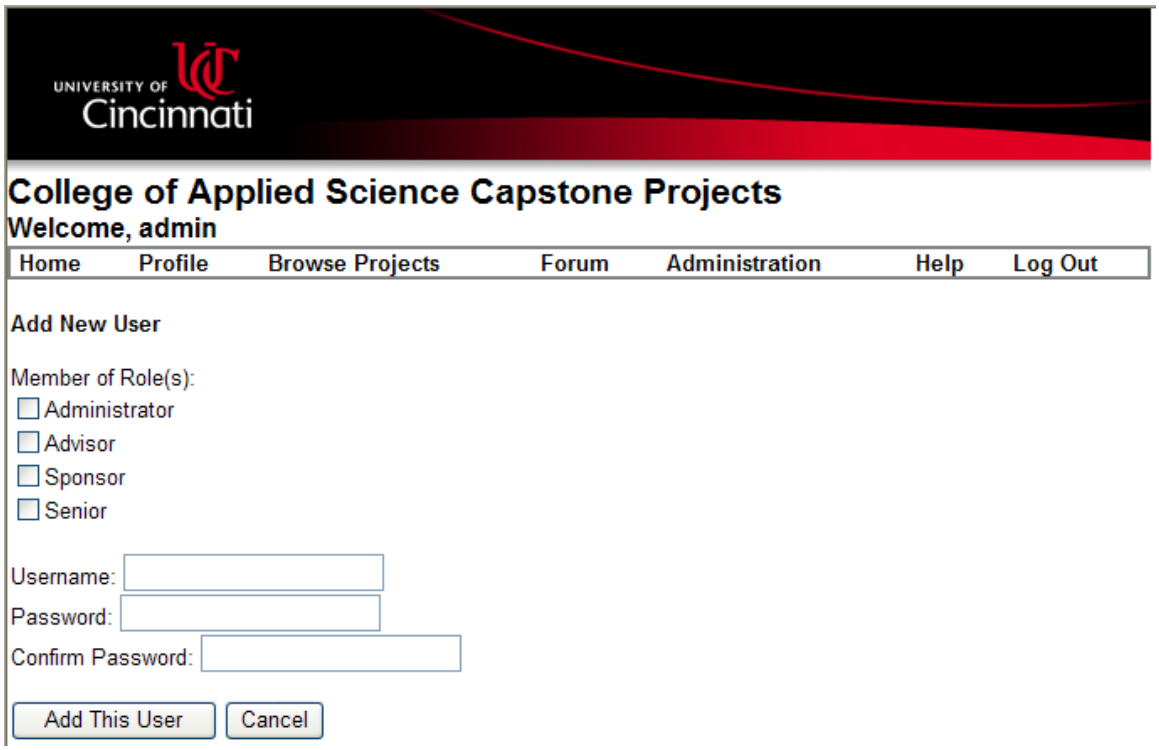


Figure 15. Manual Account Creation

5.2.4. User Searching and Reporting

Administrators may browse and edit user accounts either by searching based on criteria: either username, first/last name, or role; or by viewing a list of all users at once. Figure 16 demonstrates the user search functionality, while Figure 17 displays one of the possible reports. The reports allow for sorting and paging, and clicking the “Edit” button will bring up a wizard similar to the profile editor, except that the user’s username can also be changed and the account can be enabled or disabled. (Users with disabled accounts are prevented from logging in.) Accounts can also be deleted from this wizard, but only if they are not sponsor accounts which have posted projects.

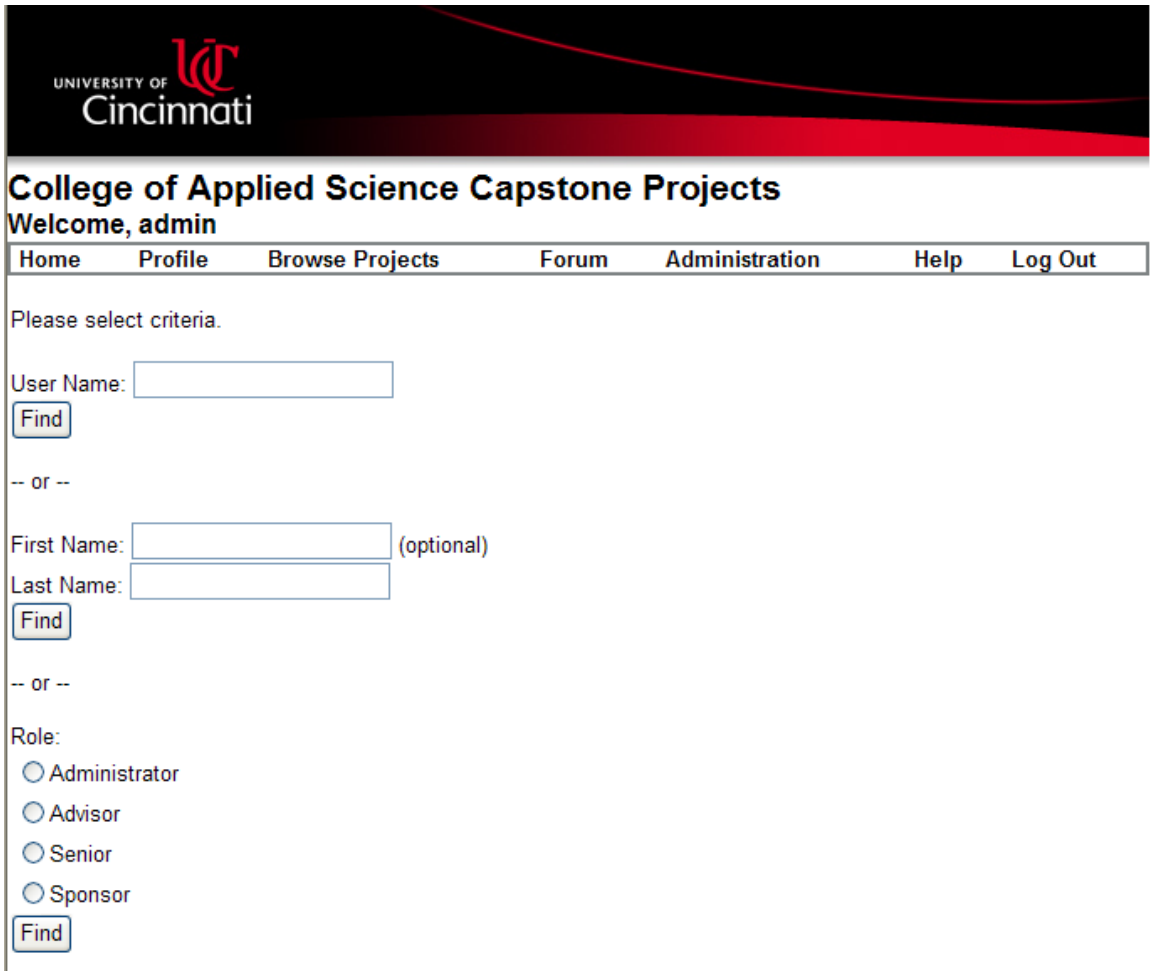


Figure 16. User Searching

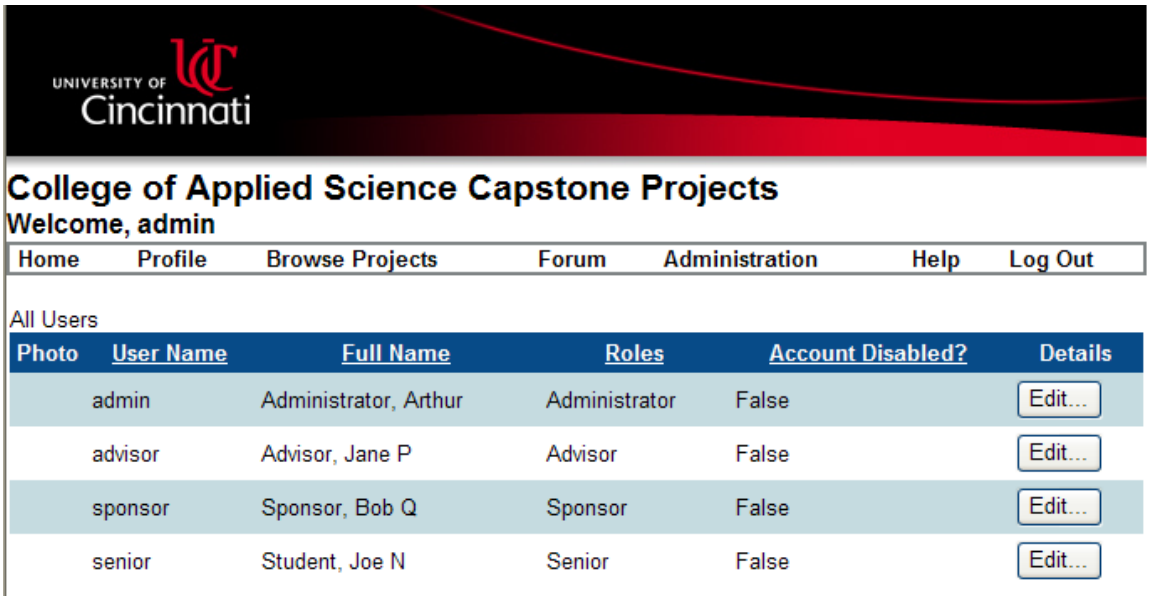


Figure 17. User Report

5.3. On-line Help

The on-line help section exists to help users navigate the Web portal. When a guest arrives at the Web Portal, the help section will show only general information on what this Web portal is about and how to create a sponsor account. If a user with role(s) logs in to the Web Portal, the content of the help section shows information and guidance tailored to the user's role(s) (see Figure 17).

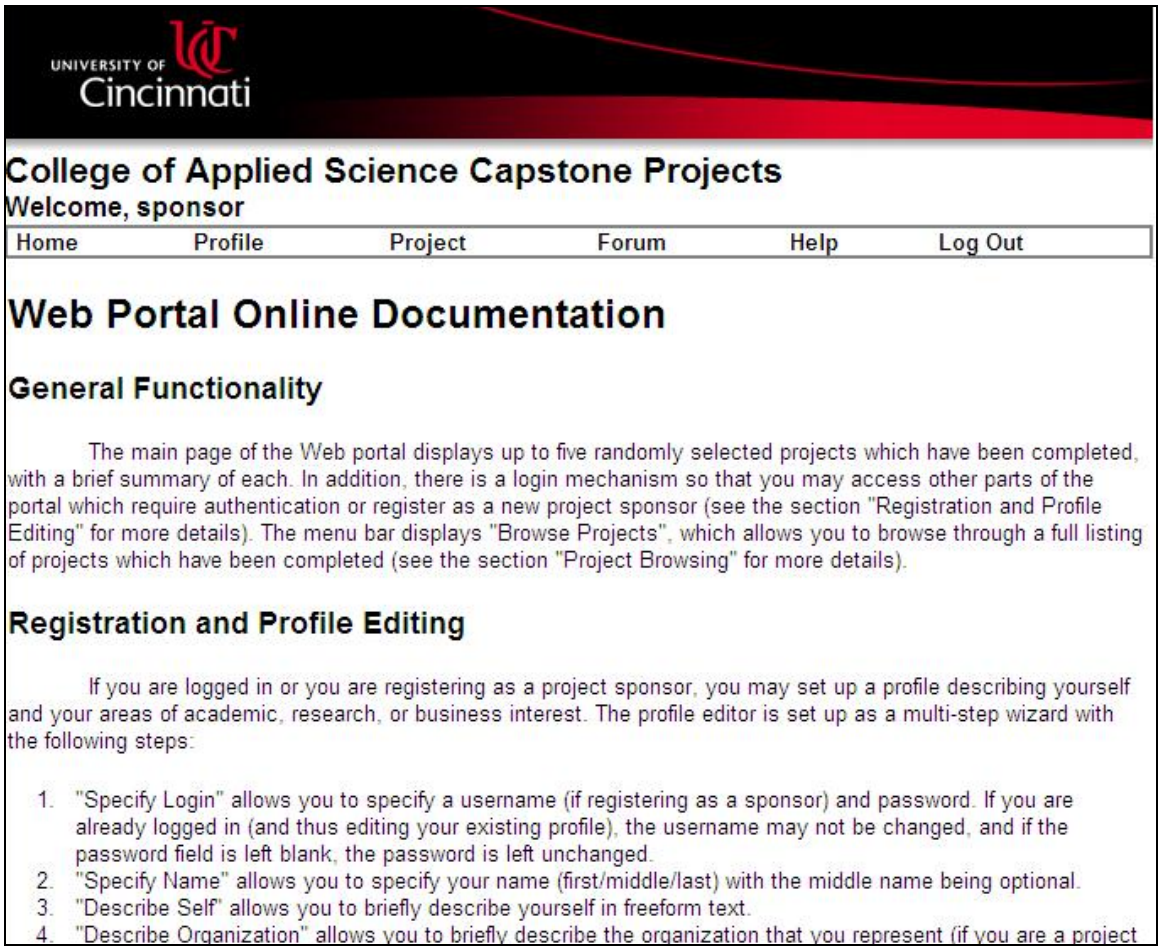


Figure 18. On-line Help

6. Testing Procedures

Throughout development, we tested new functionality as it was added, and also tested old functionality on occasion to make sure it was not broken by later changes. At the end of the development cycle, we also tested all of the functionality we wished to demonstrate at Tech Expo and at our final presentation. Looking back on this project, it seems we should have conducted much more extensive and rigorous testing; though it may have seemed like a waste of time at first, on a project of this scope the following additional types of tests are in order:

- Automated unit/regression testing – that is, writing test cases (before coding anything functional) that can detect errors in code as they are created.
- User acceptance testing – that is, making sure that we have designed what the end users actually want by discussing the project with them throughout development.
- Beta and load testing – that is, having many users attempt to use the system to see whether it can handle the load, and gathering feedback from those users on their experiences.

Unfortunately, given the time constraints and our other coursework, we were unable to perform more than minimal testing.

7. Conclusions

Though it was eventually decided that our project would not actually be used by the College of Applied Science, working on the project was still an excellent learning experience. We learned, sometimes by being told but often by trial and error, of the need for communication, for documentation, for planning, for testing, and finally for sheer persistence. We completed most of our deliverables – the only feature missing is the ability to donate funds or other resources to a project. All in all, this project, while difficult and stressful at times, has taught us a lot about software development and about project management. Hopefully when we go off into industry, then, we will be prepared for the challenges ahead.

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