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ABSTRACT

This paper describes a structured methodology used in a World Wide Web development course, offered at Purdue University (Indiana), to build complete Web sites for local businesses; the methodology includes planning, analysis, design and development, usability testing, implementation, and maintenance. The Web site team project is then described, including the following components: (1) team profile/objectives; (2) company selection and client/Web site objectives; (3) project proposal; (4) site design and resources; (5) prototype I and company feedback; (6) prototype II and usability test results; (7) Web site presentation; (8) final documentation with team evaluation; and (9) individual evaluation. Based upon the written evaluations included with the final project documentation, students felt this project was the most valuable learning experience of the course. Furthermore, the positive relationship established with the clients made the project serve as a bridge between business and academe. (Contains 14 references.) (MES)

A Structured Approach to Teaching Web Development

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Abstract: Teaching students to become web developers requires a hands-on approach. Incorporating live clients into student projects, instead of using case studies or mock companies, adds a dimension that exposes students to the realities of web development. This paper will describe a structured methodology used in a web development course to build complete web sites for local businesses. Based upon the written evaluations included with the final project documentation, students feel this project is the most valuable learning experience of the course. Furthermore, the positive relationship established with the clients makes this project serve as a bridge between business and academe.

Introduction

Two years ago, the US government increased its estimate on the number of unfilled IT jobs from 1 million to 1.3 million (Baldwin, 1998). Haubold reports that each year there are more than 400,000 unfilled IT positions including programmers, systems analysts and IT specialists (2000). Paul reports that the demand for IT services is growing at 25 percent per year (1999). Nowhere is this trend more apparent than in web development. In 1994, three million people used the Internet. The number of Internet users was projected to grow to approximately 320 million by 2000, and to 720 million by 2005 (Meares, 1999). There are several reasons for such an explosive growth on the WWW: ease of publishing; relatively low cost of having a Web presence; low training needs because of the simple, link-based navigational model; ease in updating and distributing information; platform independence; and the potential of reaching a wide audience (Forsythe et al., 1998).

The architecture of the World Wide Web has evolved to the point where large and small businesses will have to be prepared to compete with those who employ Web-enabled business models to offer better responsiveness and a lower cost infrastructure (Taylor, 1998). Consequently, experienced people with web technology and management skills are in high demand and command high salaries (Violino, 1998).

Purdue University's Computer Technology (CPT) Department produces graduates who can immediately assume responsibilities as systems analysts, database administrators, webmasters, and application programmers. The primary reason for this employer confidence is that the CPT curriculum provides students with practical experience applying important concepts using popular, commercial technology. In the area of web development, students learn fundamental web development concepts and gain experience designing and implementing a real web site. Since web applications are a special-type of software, the web development process should closely model the software development process (Schulz, 1997).

Before teaching students traditional systems development, most curricula require students to develop programming skills. Likewise, before expecting students to build a web site, it is necessary to equip

them with fundamental web development skills. In the web development course, students are taught how to write HTML, JavaScript, VBScript, and DHTML code, and how to use Microsoft FrontPage and other tools to create web pages. Students also learn how to create image maps, forms, frames, tables, and style sheets. After discussing each of these topics, students complete weekly lab assignments to reinforce the new concepts. In addition to teaching how to use the technology, students are presented with a structured process for web site development. Throughout the presentation, there is major focus on the needs of both users and clients.

Web Development Methodology

Since the majority of students in the class are new to web development, it is important to provide them with a framework for the web development process. (See figure 1) The methodology employed in the class adapts features of traditional systems development methodologies to web site creation.

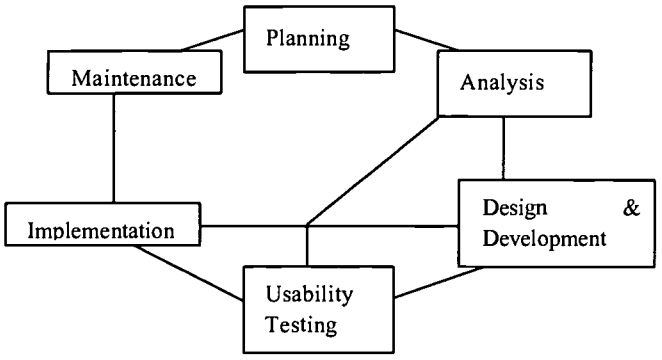

Figure 1: Web Development Methodology

The process begins with planning activities that include identifying the roles of each team member, defining who the clients and users are, and specifying the goals of the web site. Next, the proposed site needs to be sufficiently analyzed such that the developer can identify web content and organization as well as the anticipated process that the user will employ when visiting the site. Once enough details have been defined, the team should begin defining styles to be employed across the site for a consistent look and feel. This should also include designing individual pages, including graphics and multimedia. The design is frequently prototyped, so that initial user reaction can be collected.

The ease with which web novices can create a web site today and the potential value that a site can bring to the organization has resulted in an unprecedented number of sites. However, many sites have failed to realize their potential because they disregarded users' needs and requirements (Sano, 1996). For this reason, one of the most important elements of the project is the design of usability tests and analysis of the results. Students are encouraged to conduct usability testing throughout the project. In addition, they are required to include their usability tests in two separate milestones.

Based upon the results of the usability testing, there may be a need to update the design or even go back and conduct further analysis. These steps are repeated until the usability tests suggest that the site meets the user's expectations. Once that happens, the site is implemented on a production server. Usability tests should be repeated to insure that any unique aspects of the published site present no new problems. Again, the steps may be repeated as appropriate, until the client is satisfied that the site is complete. At this point, the client is educated on the maintenance activities such as registering with search engines and verifying that all links work.

Web Site Team Project

Once students have acquired fundamental web development skills through the weekly lab assignments and they know the recommended web development methodology, they embark on a team-oriented, web site development project for a real client. The project itself is divided into the following nine milestones to help the students follow the web development methodology advocated by the instructors:

1. Team profile
2. Company selection
3. Project proposal
4. Site design & resources
5. Prototype I and company feedback
6. Prototype II and usability test results
7. Web site presentation
8. Final documentation with team evaluation
9. Individual evaluation

Team Objectives

The preliminary task is to define the student teams such that each team has as close to the same background profile as possible. Students are surveyed about their related experiences and comfort level with a variety of web technologies. The instructors use the survey data to assign teams of 3-4 students with a balance of experience across all teams. For example, if only 20% of the students have substantial programming experience, each student would be placed on a different team, so every team can benefit from the programming skills of one member. Some team guidelines follow:

- Team members should have compatible schedules outside of class. To deal with this issue, each team is asked to identify three hours outside of class when they could have team meetings. Additionally, each individual team member is asked to identify three to seven hours outside of class to do work on the project.

- It would be helpful to have someone with *little to no* web development experience. It would be helpful to have someone with *some* web development experience. The instructors meet this goal by assigning students based on the results of the survey data.

- The team must designate a leader who will schedule and run all team meetings as well as serve as the team's spokesperson on communication with the instructor. The team must designate a company liaison that will be responsible for maintaining communication with the company representative. The team must designate a secretary who will record minutes from all meetings, and disseminate to all members and instructor. Teams are permitted to alternate this role, but this must be documented. The students determine their roles after their initial meeting.

- Each team member must maintain an individual log of activities related to this project. The logs may be checked each week in class and are a required part of the final project report.

Client & Web Site Objectives

Once the team has been assigned, they must identify an organization that wants to develop a presence on the Web. The organization can be a for-profit business, not-for-profit company, student club, etc. The scope of the web site should be neither too broad nor too trivial. Students are not expected to build an exhaustive web site that allows the company to conduct all of its business through the web site. Likewise, there is little value in developing a web site that documents a minute, unimportant, uninteresting aspect of the company. The teams have to find a balance that considers their schedules, the total calendar time allotted to the project (approximately 10 weeks), and their web development skills. To abet the students in this area, the instructors define minimum web site features that constitute 75% of the project requirements. The student team, in collaboration with the client, determines additional relevant features to add to the site for the remaining 25% of the project.

Minimum project requirements

The minimum project requirements are objective and fairly easy to meet. In the past three semesters that the course has been taught using a live project, only one team failed to meet all of the minimum project requirements. These requirements include:

- The complete site must include at least 10 web pages
- The home/main/start page must provide internal web site links as well as related links to external sites.
- A formal navigation standard should exist across the site (frames, buttons, menu bar, etc.).
- User information should be collected after validation assures acceptability of data.
- The site should provide company contact information (name, address, phone, fax, email).
- Any external resources used should be credited.
- The web pages must use the user's vernacular.
- The pages must be arranged in a logical fashion.
- Unnecessary or irrelevant information must be omitted.
- Images should be used, where appropriate, to convey more meaning or attract attention, but not at the expense of too much load time.
- Usability tests should be conducted throughout the project to support the point that the site continues to meet the user's needs.

Additional project features

The greatest challenge that students face is determining what additional requirements should be incorporated into their site such that they bring value to the client and target users and the challenge level warrants additional credit. To help the students with this subjective part of the project, the instructors demonstrate past student projects as well as give the students a list of possible enhancements that could qualify for the remaining 25%. The list of suggestions shared with students is below:

- Employ an image map to increase appeal and provide an alternative for linking to elements within the site.
- Incorporate security to restrict access to the entire site or to some elements within the site.
- Customize the user's experience through maintaining user data in a server database and modifying pages based on the user's profile.
- Add a floating, drop-down menu to provide access to site options without having to scroll back to the top to access the menu.
- Add relevant games (word search, hangman, tic-tac-toe, etc.) to give users a reason to return to the site.
- Add Flash movies to initially gain the new visitor's attention.

Since much of the project's success is dependent on the client, the students must identify a cooperative representative within an organization who is willing to work with them on a regular basis as a resource as well as to provide feedback throughout this project. On the second milestone, students must document this person's name, phone number, email address, role within the organization, and expected role on their project. More importantly, students must include a memo from their proposed client to the instructor accepting the role that the team has defined. If students have difficulty finding an organization, they contact the instructor to find out about any other potential clients that may be available for the project.

Project Proposal

Once the team has completed initial project planning, they must thoroughly analyze the proposed web site needs and expectations. Before they are officially allowed to develop the site, they must seek permission from the instructors by documenting their complete analysis in a project proposal. This document is written as an executive summary memo that addresses the following points:

- a 1-2 sentence statement of the proposal
- general description of the company and statement of needs for proposed web site
- outline of work to be completed, including strategy methods and criteria for collecting web site data
- development team with individual responsibilities to demonstrate that each member will be contributing equally to the project
- justification for the Web site, such as potential value of the final system
- sources of knowledge
- user profile
- benefits to all persons including the student, company, company representative, and target users
- evaluation strategy
- anticipated problems

As long as the above points are adequately addressed and all web site proposals are for different organizations, permission to pursue the proposed project is granted. However, no team member may serve as the company representative. Based on feedback from the most recent course offering, at least one student felt that no student member should be affiliated with the client organization. This is a recommendation that will be considered for subsequent semesters.

Site Design and Resources

Assuming that the proposal is accepted, students should immediately begin designing their client's site. The design must include the layout and organization of pages on the site, consistent header/footer content, and related external links. Although the design may be sketched out on paper, the majority of teams tend to use a tool such as Microsoft® FrontPage to build a prototype.

Initial Prototype and Company Feedback

Much like any other systems development project one of the most valuable things that the teams discover is that their clients are not very helpful in specifying what the sites should look like or how they should behave; however, the clients can definitely tell them when they do not like something. This helps the students recognize the value of soliciting formal and regular feedback. Therefore, once the design has been approved, each team submits its initial site prototype along with the written feedback from the client.

Prototype II and User Test Results

As previously stated, many sites have failed because they did not consider the user's needs. To address this, the teams submit their second prototype with a status report that documents their usability tests. The report must include a description of their test strategy, include samples of the user tests, include the actual data, and their analysis of the results. Although studies have shown that the optimum number of test users is five (Nielsen, 2000), the minimum requirement is ten. This helps the students realize trends and account for different groups of users.

Team Presentations

During the semester, every team is developing a site for a different client with unique objectives. One of the most interesting milestones completed by the teams is a presentation of the site to the rest of the class. Every team member is required to actively participate in the presentation. Minimum content requirements are given to the students prior to their presentation. The presentations are timed (4-6 minutes due to limited class time) and videotaped. Finally, the presentations include a demonstration of the major elements of the site. Since the presentations are completed at least one week prior to the final submissions, many teams are able to get peer feedback and ideas for the additional features that can help improve the site for the client and target users.

Team and Individual Evaluations

Once the project has been completed, students must document their experiences in a team evaluation report and confidential individual evaluations. The team evaluation includes a discussion of each student's contribution to the project and team, individual and combined lessons learned, value added through the additional features, possible future improvements, and remaining implementation activities discussed with their client. The final set of usability tests and their analysis, along with the final client evaluation are also included. The individual evaluation allows each student to share confidential comments regarding the team interaction and contributions by teammates.

Conclusion

Based upon the written evaluations included with the final documentation package, students find this project to be the most valuable learning experience of the course. Every semester that this methodology has been employed, students have been sought after for their web development experiences, often times by the web clients from the semester project. In a few cases, the clients have recommended to others that they volunteer to serve as clients for subsequent semesters. Accordingly, this project serves as a mechanism for bridging business and academe.

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