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December 6, 2005

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To whom it may concern:

I am submitting the enclosed report entitled *Report on UrbanSpeleology.com*.

The purpose of this report is to detail the work I have completed on my senior project at NMU. A copy of the source code used to complete this project may be found on euclid.nmu.edu under the path: '/staff/apoe/classes/cs480-01-5f/npattiso'. This project may also be accessed on the internet at <http://www.UrbanSpeleology.com/>.

I hope this report meets your expectations and I welcome any questions or comments that you may have when I present my project to the committee on Tuesday, December 13, 2005.

Respectfully submitted,

Nicholas Pattison

Encl: Report on UrbanSpeleology.com

Report on

Urban Speleology.com



Michigan Central Station - Main Concourse (Summer 2003)

Submitted to:
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Abstract

UrbanSpeleology.com is a website devoted to the topic of Urban Speleology (a.k.a. Urban Decay or Urban Exploration) created as Nicholas Pattison's senior project at NMU. UrbanSpeleology.com possesses many features, among which include a forum, MySQL backend, custom php sessions, user logins, and an image gallery. This site also used advanced programming techniques such as object oriented design.

In its current state, UrbanSpeleology.com requires additional work to reach its original goals. The development of the site was hindered by factors such as time constraints and the capabilities of UrbanSpeleology.com's hosting provider. A large quantity of time was spent perfecting many small details on the site to ensure that it would continue to exist beyond the scope of this project. The initial time planned for the site's construction proved to be excessively short in comparison to the amount of time that is really needed. Overall, this project did prove successful in that has, and will continue to function as an invaluable learning tool.

Introduction

For a number of years, I have had an interest in old buildings. Unfortunately, many old buildings have fallen out of repair and have been left abandoned. As time progresses, it no longer becomes economically feasible to restore these buildings to their prior grandeur, hence these buildings are torn down and lost forever. Some examples of such buildings are the Hudson building and the Statler Hotel, both former landmarks of Detroit. However, a number of buildings such as the Michigan Central Station of Detroit and the Holy Family Orphan's Home of Marquette are still standing, but they are slowly decaying and one day may too be lost and forgotten.

I first took an interest in the Michigan Central Station of Detroit, abandoned in 1987. For many years, I have always had an interest in going inside the building to see what has now been forgotten. Over time, this interest of mine has expanded to encompass many other buildings around the world. My first opportunity to explore a building occurred when I was living in Houghton. Houghton is located in an area that grew as a result of copper mining, however, due to economic reasons and strikes, copper is no longer mined in the area. Memories of Houghton's copper heritage are still carried on through the memories of people and the decaying buildings and equipment. It was here that I first had the opportunity to explore some of these wonderful old buildings.

Finally, in 2004, I finally mustered up the courage to go and explore the Michigan Central Station. When I enter these buildings, I always pack the quintessential tools, a flashlight, a camera, and my knowledge of what the building once was. I enter these builds to admire what once was, not to destroy it. I document my experiences through my pictures, preserving the beauty that still shines through the dust, graffiti and vandalism. Many people also share my love of these former landmarks and partake in the same hobby. It was their sharing of information and photos that first got me started on this hobby. Now I would like to return that to the community.

Once I got my first set of photos developed, they were available on the internet by the day's end. As I accumulated more images and experiences, I soon outgrew the capabilities of plain html to effectively share my experiences. I started self-teaching myself advanced web page design through the use of cgi and php. As a student at NMU, I took programming courses and applied my new knowledge to further developing my website devoted to urban speleology.

When it came time to choose a topic for my senior project, I saw no better topic than to build and construct a comprehensive website to assist me in

detailing and sharing my experiences with others. But I did not want this website to be limited to just my experiences, so I chose to create a website that would appeal to the urban speleology community by allow the exchange of information and experiences through features such as an integrated forum.

Initial Plans

Currently there is a wealth of information in existence pertaining to the topic of Urban Speleology, from online LiveJournal communities¹ to user created webpages. Even with the vast array of information out there, it is difficult to find a comprehensive site that is run by the community. Sites, such as the LiveJournal community, still rely on the users to provide their own hosting for the images they upload and lack good organization of the data. Other sites may feature good data organization, but the information on the site is often the product of a small group of acquaintances. My initial goal was to start an online community that combines the best features of all the other resources currently available.

Creating such a site is a major undertaking. Shortcuts are available, such as incorporating various freely available packages into a single site. This methodology unfortunately leads to a site that appears disjointed. The forum may be of a vastly different design than the image gallery or the main page of the site. To create a site that follows good design principles, much of the content must be custom created. This was my initial goal with this project.

As I started creating the site in a detail oriented fashion required of a professional appearing site, I discovered that this was a more complex task than originally thought. Since I was creating the site out of devotion to my hobby of urban speleology and as a learning tool to advance my own personal knowledge, I was willing to put the extra time required to make UrbanSpeleology.com a reality. I initially hoped that I would have a complete and professional appearing site up and running by this time, I later realized that to perfect such a site, it would need to be a continued project well beyond the completion of my senior project. Whereas the site still needs many improvements, features, design work and bug fixes, I still feel it is a major accomplishment for me as a single person project. Even in the state of the project now, I am proud of the time and work invested and plan to continue work on the site in the future.

State of the Site

The result of this project, UrbanSpeleology.com, is currently up and running on E-rice.net's web hosting service². E-rice.net was chosen as the host for this site due to their economical prices. To be truly successful, UrbanSpeleology.com would require a more comprehensive hosting service, but such a service is not currently affordable at this time. Much of the desired functionality of UrbanSpeleology.com cannot be implemented until the needed hosting services are obtained. This is due to limitations of the current host, among which include disk space, bandwidth limitations, lack of cgi capability, an older version of MySQL³, php running in safe mode⁴, and lack of shell access.

UrbanSpeleology.com currently features a working forum, user accounts, an image gallery, and website administration features. These features are detailed below in the Features of Interest section. At the time of writing, UrbanSpeleology.com was just announced on LiveJournal's Urban Decay community⁵. It is hoped that enough user interest will be developed in the coming months to create sufficient user base for this site to become a valuable resource. If successful, it is hoped that UrbanSpeleology.com may start generating revenue to provide for better hosting. It should be noted that UrbanSpeleology.com is not a for-profit site. If income is generated in the future, it will be reinvested in the site in terms of improved hosting services and/or the hardware required to run the site.

A large quantity of work still needs to be completed to accomplish the initial goals of the site. Additional features need to be created and implemented, as well as continued refinement of those already implemented. A current weak point of the site is the actual web design itself. As I am not a design expert, I may seek the assistance of an individual(s) to assist in creating an eye friendly design. The administration section of the site also needs to be improved. Features such as the ability to deleting posts and better page content tools would further the value of this site. Coupled with a better hosting service, this will also allow users to submit their own photos to the site.

Adding data to the site and creating posts still requires a basic knowledge of html to correctly insert links, images and varied typefaces, line breaks, etc. Adding a WYSIWYG interface written in Javascript would aid in inexperienced web users to successfully use the website. A search feature also needs to be created. It is hoped that as the site gains popularity, its PageRank on Google⁶ would increase, thereby bringing more users to the site, but once they are at the site, a search feature would assist them in finding their desired information.

An additional number of smaller refinements, features, and bug fixes also need to be made on the site. Such examples include advanced forum/post/comment controls, emailing of users, and formatting times based upon the user's locale (this was attempted, but restrictions in place as a result of php running in safe mode hampered this feature).

Features of Interest

During the construction of UrbanSpeleology.com, a number of desired features were implemented. Each one presenting its own unique set of challenges and learning experiences. A detailed description of the main features of UrbanSpeleology.com are provided below.

Object Oriented Design:

As the site was coded, a trend was noticed when constructing the user forums. In many instances, the same code needed to be copy and pasted with only minor changes. This prompted exploration into the class and object oriented design support in php⁷. It was found that php supported programming tactics such as classes and inheritance. However, php's implementation of classes and objects is not as extensive as in other languages such as Java.

Creating an object oriented website does present some interesting challenges, such as situations in which php is used to output page specific formatted html code. Whereas the object oriented design may reuse code for this site, its portability to another website would require modification of the html code to conform to that site's design schema. The majority of the forum section of the site was written to follow an object oriented design. However, portions of this site were constructed before I discovered the principles of object oriented design, therefore they are not coded in the object oriented fashion.

A key object oriented portion of the forum are the classes for comments (comments.php) and posts (posts.php). Each class had a lot in common with each other, with only minor differences or extra functionality. To reuse the common code, a class named genericPost (genericPost.php) was created and extended by both classes. In most cases, functions were overridden in a similar fashion to java. One complication was that in java, you can call super() to call the constructor of the parent class, then add additional functionality in your constructor. In php, you can't do this. To work around this problem, the constructor was placed in the genericPost class, with the last line calling the _constructor() function, which then allowed the subclasses to add additional functionality to the constructor.

Another interesting problem that was encountered was that php does not allow for the overloading of functions. Therefore I was unable to have two constructors (each with different arguments) in one class. This was solved by having the constructor see what variables were defined, then call different functions in the class to finish constructing the class. To avoid overloading other functions, all I had to do was to rename the function and track the different names.

Custom PHP Sessions:

One of the requirements for UrbanSpeleology.com was to allow for user logins. A simple way to accomplish this task was to use .htaccess files with apache. This approach, while secure, has limited functionality. The intent of this site was to allow user logins to provide such features as posting access to the forum. However, the data in the forums needed to be freely available. To accomplish this, the original plan was to use the built in php session functions⁸. The built in functions lacked the ability to store the sessions in a database, by default they were stored in /tmp. Whereas this would have been acceptable if I had access to /tmp, the site was hosted on a server where I don't have shell access, thereby making the debugging of php sessions difficult.

While researching the functions and capabilities of php sessions, I discovered various functions, such as `session_save_path()`^{8a}, but was unable to find a way to store the sessions in a MySQL database. Through research on how sessions worked, I took a stab at creating my own session class (sessions.php). By writing my own php session class, I was able to add all of the functionality to the sessions that I desired.

My custom php sessions use http cookies to store a random md5 session key on the user's machine. When a request is made to the web server, the session class checks the session key against the keys stored in the database. If a match is found, the user's session information is then retrieved from the database. Each session is only valid for 30 minutes from the last request to UrbanSpeleology.com. Checks are performed on the database to ensure that the session has not expired. If the session is still valid, then the expiration time is then updated to reflect 30 minutes from the time of that request. This way, a user may stay logged in all day provided that they make at least one request every 30 minutes. If the time between requests exceeds 30 minutes, the user is required to log in again.

A potential security hole in this design is that someone may intercept the user's session key. To help combat this vulnerability, when a user logs in, their IP address is stored in the database along with their session

information. If their IP address changes (as may occur when changing locations with a laptop), they will then be required to log in again even if their session has not yet expired. This prevents a third-party from easily attempting to intercept and use their session information.

There are still limitations to my custom php sessions. When a user logs out or they make a request with an expired session, their session information is also deleted from the database. However, if their session expires without them logging out or making an additional request with that session, the session information will be retained in the database until it is manually cleaned out. Ideally, a cron job could be created to remove expired sessions from the database, but since I don't have permissions to create cron jobs on the remote server, this solution is not possible. A simple clean-up function could also be incorporated into the session class, but this would need to run automatically whenever an instance of the session class is created (which creates an additional MySQL query, thereby leading to potential inefficiencies and slow downs).

User Accounts:

Each user needs an account to create posts and comments on the site. Additionally, site administration (see Dynamic Page Creation below) also requires the user to have an account. Currently, two types of user accounts exist on the site, standard member and administrator accounts. As the site grows, room exists for additional account types such as moderator accounts. To create an account, a user must go to the registration page and fill out the required information. Once they complete this task, their account is stored in the MySQL database.

During the registration process, users may also create a profile featuring optional information such as their instant messenger handles, website, location, bio, etc. The only required information to create an account is a username, password, email address and birth date. Each time a user creates a post or a comment, it is linked to their username. If I wished to know more information about the user that created a post, all I have to do is click on their username to display their profile information. Future plans exist to incorporate such features as sending email or private messages to users.

Another feature of the user accounts is the ability to specify the account type. The account type flag is used to display or hide various links and data based upon their account type. If a standard member account logged in, they would only see four links on the left, but if an administrator logged in, they would see two additional administrative links.

Dynamic Page Creation:

One section of UrbanSpeleology.com features photographs and textual descriptions of abandoned and/or decaying sites. Currently, information is only provided on buildings I have explored. In the future, I would like to add functionality for users to upload their own photos to the site, thereby creating a database of places worldwide. However, due to disk space limitations (200 mb storage, 6gb monthly transfer), I have left this site limited to only my explorations. In the future, if this site were to prove successful, I may plan on expanding it to allow users to add information of their own explorations. To pave the way for this desired expansion, I have created a way for the pages to be automatically generated from information stored in a MySQL database.

As it stands now, I only have content listed for less than ten sites throughout the state of Michigan. Due to the small number of sites, creating a dedicated html page for each one would be a manageable task. However, as the number grows, so must the number of html pages, thereby creating an unmanageable site. If I ever chose to change the design, add additional links, etc., I would be faced with the daunting task of modifying a large number of pages. To allow for growth, I used a php include for the navigational sidebar and created a template for the page data.

Navigational Sidebar:

To help keep the navigational links manageable, I created a navigate class (navigate.php) that is included on every since page on the site. If I wanted to add a new link to the site, I only need to add it to one page. I also used a tree structure when creating the sidebar. When a user clicks on a main topic on the sidebar, a drop down list appears. For example, when you first view the page, only four links appear on the side. But when you click on 'Urban Decay,' additional sub links are displayed. A combination of php and css programming was used to develop this.

If you viewed the page source of the main page (index.php) on my site, you would notice that all of the urban decay links are listed on the sidebar, but they do not appear on the screen. I managed to hide the unwanted links by using classes in css. There are css classes for hiding items, items with sub-topics, items without sub-topics, etc. All I would need to do is simply change the css class of an item to affect how it was displayed.

My navigate class reads the location of the current page that the user is viewing. By determining the current directory, the php script determines what css class it should apply to each link. This way I am able to store all of

the sidebar links in a common place and have them dynamically decide what ones to display depending on what page I'm viewing.

Page Templates:

To accommodate the easy management of a large number of pages, a simple template was created. Then, through the usage of POST and GET variables and php, I am able to generate a MySQL query to retrieve the page's content. For every page in the urban decay section, information can be retrieved from the database to populate the page title, meta keywords, meta description, number of photos associated with that page, and text on that page. By this method, I only needed three files to create the urban decay section: a main page (index.php), a photo index page (photo_index.php), and a photo page (photos.php).

Page Modification:

Since the majority of website's data is stored in a MySQL database, it is possible to create a web interface to add, edit or delete various data from the pages. When a user logs in with an administrative account, they are presented with links to an interface to perform these tasks. There are limitations to what functions I was able to incorporate in this section since php is running in safe mode, so some tasks still require modifying source code. However, with a few clicks, an administrator can retrieve and update the information in the MySQL database. This negates the need to use a tool such as phpMyAdmin⁹ to update the site. This functionality will also help the site achieve its future goal of allowing users to upload their own data as well as allowing such tasks as editing and/or moderating that data.

Image Gallery:

The main feature of the urban decay section of the site is an image gallery for each site. The original intent was to allow images to be uploaded through a web interface. To accomplish this, I considered two different image storage options: storing the images on the hard drive or in the MySQL database. However, due to limitations of the hosting provider running php in safe mode, image uploads were not implemented on the site. At the current time, the images are stored on the hard drive using a consistent naming schema. This naming schema would ease the transition to storing the images in the database if this change was desired. It also assists the php script in attaching captions from the database when displaying images.

When a user first requests to view the photos related to a specific site, they are presented with an index of photos. Each index will display up to 25

thumbnails of the full size images with buttons to navigate to other indexes in the series. Currently, for each image, a full size photo and a thumbnail are stored on the server. Whereas this approach uses more disk space, it does allow the index to be rendered quicker. It is possible to generate thumbnails on the fly through php add-ons such as image-magick¹⁰, but this requires a higher CPU overhead and additional time to create the page.

When a user clicks on a thumbnail in the image gallery, they are presented with the full size image. Each full size image may also have a caption that is stored in the MySQL database. Controls exist to navigate through the full size images in series or return to the related index that the photo is featured on.

User Forums:

Another section of UrbanSpeleology.com features user forums. Here, users of the site may discuss various topics of interest. This forum is integrated with the user accounts on the site. The contents of the forum and the posts are available to anyone visiting the site, but to actually create a post or a comment, a user must be logged in. To create the forums for the site, I was presented with two options, code them myself or to use a forum package such as vBulletin¹¹ or phpBB¹². However, many packages do not allow one to create threaded topics. Plus, what would be the fun in using one that was already made?

The forum I created was based upon the looks of vBulletin and LiveJournal. The forum packages currently available feature a more comprehensive list of features compared to mine, but it also must be considered that those are multi-person projects. I had to concern myself with other aspects of this site in addition to the forum. In the future, I would like to add features to my forum that allows for searching, the ability to delete posts, sub-forums, etc. As it stands now, users can only create posts and comments in my forum.

One highlight of my forum is the ability to thread comments in a fashion similar to that used on LiveJournal. All of the comments on a post are displayed on a single page. To differentiate a sub-comment from a regular comment, it is indented and displayed under the parent comment. To accomplish this, each comment is treated as a post (which lead to the incorporation of an object oriented design). When a post is retrieved from the database and displayed on the screen, a query is performed to see if any comments list that post as its parent. If comments exist, they are ordered by date and displayed on the page. As each comment is displayed, it checks to see if it has any children. If it has children, it instructs them display

themselves in an indented fashion. This process may continue to create comments many levels deep.

Conclusion

The initial plan of UrbanSpeleology.com was for a site that would continue to be updated and maintained long after this project ended. As a result of this intent, extra time was devoted to small details of the site. Whereas this site may have easily been completed with less work, the detail minded focus of its construction will help to ensure its longevity after this project's completion. Limitations were also imposed upon the site by the capabilities of its hosting provider.

It was hoped that the site would have been closer to completion by this point in time. However, all things considered, the site has made sufficient progress. When creating a site such as this one, there are many minor details that, while they may seem small, require significant work to implement. The main objective of this site was to be a project that I would enjoy working on, but at the same time gain knowledge and experience. I feel that objective has been satisfactorily fulfilled.

This project was broad in nature. As a result thereof, a number of different concepts were applied in this project. Some concepts, such as advanced web design and object oriented principles, assisted in supplementing and extending upon concepts learned during my course work at NMU. Other concepts, such as an in-depth understanding of sessions and dynamically generated page content, required me to transverse from what was learned in the classroom into new subject matter.

Overall, this project has proved to have been an invaluable learning experience. The care taken to create a quality website from day one and the quantity of time invested in this project has left me with a site that I am not only proud of, but that I want to continue to work on. By doing so, I will be able to further expanding its possibilities, but more importantly, gain experience and knowledge.

Appendix

1. LiveJournal - <http://www.LiveJournal.com>
2. E-rice.net - <http://www.E-rice.net>
3. E-rice.net runs MySQL version 4.0.22. The current version of MySQL is 4.1.15. Starting with MySQL version 4.1.x, additional features were added, among which include full support for subqueries.
<http://dev.mysql.com/doc/refman/4.1/en/subqueries.html>
4. PHP safe mode attempts to secure the server by imposing restrictions on the functions that a php script may call.
<http://us3.php.net/features.safe-mode>
5. LiveJournal's Urban Decay community -
http://www.livejournal.com/community/urban_decay/
6. Google PageRank - <http://www.google.com/technology/>
7. Classes and Objects (php4) -
<http://www.php.net/manual/en/language.oop.php>
8. PHP Session Handling Functions - <http://us3.php.net/session>
 - a. PHP session_save_path() function call -
http://us2.php.net/session_save_path
9. phpMyAdmin - http://www.phpmyadmin.net/home_page/index.php
10. ImageMagick - <http://www.imagemagick.org/script/index.php>
11. vBulletin - <http://www.vbulletin.com/>
12. phpBB - <http://www.phpbb.com/>