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3D INTERACTIVITY VS. 2D INTERACTIVITY:
USING 3D TECHNOLOGY FOR WEB NAVIGATION

presented by

JESSE PAGE

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3D INTERACTIVITY VS. 2D INTERACTIVITY:
USING 3D TECHNOLOGY FOR WEB NAVIGATION

By

Jesse Page

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Telecommunication, Information Studies, and Media

2004

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ABSTACT

3D INTERACTIVITY VS. 2D INTERACTIVITY: USING 3D TECHNOLOGY FOR WEB NAVIGATION

By

Jesse Page

To date. most web sites that have utilized 3D technology have been purely exploratory. That is. the user only has the capability to navigate around the environment without point and click capabilities. Like flash. the interest level pertaining to 3D technology and its use in web development has dwindled amongst users. There is a craving for more interactive 3D interfaces that allow for point and click interactivity. Can 3D technology be used as a functional. efficient component in interface design for the web?

The objective of my thesis was this: to create a functional. efficient website that utilized 3D technology for navigation and to display content. and then test its functionality and practicality by subjecting it to user testing. Ultimately. this testing helped to give an indication as to whether 3D technology would be a viable alternative to 2D technology in the production and development of web sites.

DEDICATION

To my mother and father, Ron & Joanne Page, for supporting me through all of my
academic endeavors.

ACNOWLEDGEMENTS

Again, I would like to thank my mother and father for all of support, both financially and mentally. Without their help, I would have never realized my academic potential, and I would have never accumulated so many years worth of great memories from attending college. They are, and will always be, the two people I respect most.

I would like to thank Brian Winn for being my primary advisor for this production, and Carrie Heeter and Dr. Tom Muth for being my second and third advisors. Without all of their guidance and help, along with the many courses I have taken under their tutelage, it would have been very difficult to do any of this.

Finally, I would like to thank Matt Larson for sending me images that helped with the design aspect of this production and Zoo Chae for letting me use his office. When I was looking for a place to conduct subject testing, he was one of the first persons I turned to. Hopefully I did not leave it in too big of a mess.

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"Images in this thesis are presented in color."

Introduction

When Flash was first introduced as media that could be used in combination with HTML, there was an influx of Flash media used for many sites. One common use of this media was to provide a splash page that would serve as an introduction to a site. There would be some type of animation, and then the user would then be re-directed to another page that contained the actual content. At first, there was a great amount of interest in Flash technology, which fueled more development of Flash media for this type of use. However, because of overuse, many users became annoyed with sites that used Flash media. Many users just wanted to get to a site, access the information they were after, and leave in timely manner. Realizing this type media was becoming a nuisance, most developers turned their focus to using flash as an advertising tool, as well as a tool to create entire web page interfaces.

Web developers that utilize 3D technology and media are coming to a similar crossroad. To date, most web sites that have utilized 3D technology have been purely exploratory. That is, the user only has the ability to navigate around the environment with very limited point and click capabilities. And like flash, the interest level and demand for these 3D applications dwindled amongst users, after it established an identity as strictly a visual tool. There is a craving for more interactive 3D interfaces that allow for point and click interactivity. Can 3D technology be used as a functional, efficient component in interface design for the web? This is what I set out to answer.

The objective of my thesis was this: to create a functional, efficient website that utilized 3D technology as means of navigating through content, and then test its

functionality and practicality by subjecting it to user testing. Ultimately, this testing helped to give an indication as to whether 3D technology would be a viable alternative to 2D technology in the production and development of websites. An analysis of the data taken from subject testing, details of the production, and my final thoughts and conclusions are documented in the following sections of this report.

For this production, two websites were needed. An existing 2D commercial website was used as a source for articles and publications, and was also used during the user testing stages of the production. The second website was based off this pre-existing 2D site, but instead utilized 3D technology as a means to navigate through content. The creation of the 3D site was the main point of emphasis during the development stage.

The following section describes the applications and/or tools that were considered for use in the development of the production. These applications and/or tools included Adobe Atmosphere builder, 3D State Webmaker, and 3D Studio Max + Macromedia Director. Although a few other programs like Swift 3D, Flash, and QuickTime VR could have been included in this list, ultimately they were not considered viable options because my familiarity with using these tools for 3D development was very minimal.

Applications Considered for Development

➤ **Adobe Atmosphere**

Adobe Atmosphere is relatively new authoring tool that specializes in the creation of "3D interactive stage sets". With this tool, developers have ability to present a variety of media components such as three-dimensional objects, Flash media, sound, and video "all within the context of live theater performance"[1]

One of the most intriguing tools within the Atmosphere builder is ability to insert portals within the environment. These portals are usually represented as animated

objects to which users can virtually walk through in order to get to another area of the environment. With the ability to integrate portals into the environment, along with other types of interactive media, Adobe Atmosphere is an ideal application to use for the creation of virtual tours, presentations, and other related content. On top of that, Adobe Atmosphere also includes the ability to chat with other users. In a review by PC magazine, this was described as one of the main selling points: "Viewers can not only see interactive 3D objects but can also collaborate with other viewers in the environment"[2]. Figure 1 below shows a sample layout of the builder interface.

Figure 1

An example cathedral scene designed with Adobe Atmosphere:
from Adobe.com

Although Atmosphere makes navigating virtual environments less tedious, and allows developers to integrate other types of interactive media, this environment is still mainly exploratory. There is very little (if any) point and click capabilities within the 3D environment itself. This makes it difficult to consider Adobe Atmosphere as a viable

application to use in the creation of 3D web interfaces that require constant point and click interaction from users.

Adobe Atmosphere applications also require the user to download an Atmosphere player, which is more than a plug-in. As a review from ZD Net states, "At more than 2MB, the Player is not a lightweight download for those using a dial-up connection, but it is a heavy lifter"[3]. The player utilizes an entire interface that enables users to view the 3D content, as well as control other aspects within the environment such as the selection of avatars, chatting to friends, changing camera perspectives, and others. However, all interactions with the mouse take place outside the 3D world itself, using standard buttons located within the player to interact with the 3D environment. Although this certainly an interesting application, because the 3D worlds are purely exploratory and because the Atmosphere player has not been developed for both PC's and Macintosh (it is not available for Macintosh systems yet), this application was not suited for the development of this production.

> **3D State Webmaker:**

3D Webmaker is a free downloadable application that can be used for the creation of 3D interactive websites. 3D State is most popular amongst game designers due to the development of the 3D State game engine, but has since expanded. The developers at 3D State like to promote Webmaker as an easy to use tool that requires very little programming: "Even if you can't program, you can design fantastic programs with nothing but your mouse"[4] Within Webmaker, there are a variety pre-made models and effects that are made available to the developer. Models can be dragged and dropped into

the environment from the library, and when the desired environment has been created, the user can then publish with ease into a fully functional website. Figure 2 below is screen capture of the 3D Webmaker 2.0 interface.

Figure 2

A screen capture of a fireplace scene designed with 3D Webmaker

Although Webmaker has a variety of pre-made models available for use, in order to create new models for use in an environment, another application called 3D State Edit needs to be downloaded and installed. This application is capable of creating some impressive models, but does not offer the flexibility or options that other 3D creation tools offer. If a developer wanted to make a complex, detailed environment, this application may not be the best choice to use. Models created in 3D Edit are also saved

with the 3D State extension (.STATE), which makes it impossible to use with other applications such as Macromedia Director.

Additionally, web pages published out of 3D Webmaker require an Active X plug-in to be installed, and if the user does not know how to enable Active X within the Internet browser settings, they may have a hard time viewing pages created from 3D Webmaker. If 3D State continues to develop this application, it may become a major alternative to other applications that specialize in 3D creation and implementation.

➢ 3D Studio Max + Macromedia Director:

Discreet 3D Studio Max and Macromedia's Director are two applications that have been mainstays within their respective markets. 3D Studio Max is a professional 3D creation tool that has been used in a variety of ways, ranging from 3D modeling to animation and rendering solutions.[5] Macromedia Director is a powerful multimedia tool that gives developers the ability to create CD's, DVD's, Kiosks, and interfaces for the web.[6] Director also allows the developer to import and add interaction to a W3D file, which is a specific Shockwave format that can be exported out of 3D Studio Max.

When used in combination, 3D Studio Max and Director provide a powerful way to produce and implement 3D content for web use. Entire environments can be created in 3D Studio Max, and by using the 3DPI Xtra and additional Lingo coding in Director, models can be made interactive with point and click capabilities. Additionally, Director can also be used to add navigation and movement to cameras and models within the scene, which makes it ideal developers seeking to add a 'first-person' perspective to navigation. And like Flash, which is another timeline-based application, Director can

also be used to create the entire web interface to which the developer can publish directly

into an HTML page.

According the a recent survey conducted in March 2004 by NPD[7], the Shockwave

plug-in it requires to run in browsers has reached a higher penetration amongst users than

some of the other plug-ins or media players required for similar applications (see figure 3

below for more information). With the capabilities of these two applications, 3D Studio

Max and Macromedia Director were the obvious choices to use for the production of the

3D interface and virtual environment. Screen captures of these two applications can be

found in the production chapter of this report.

Figure 3
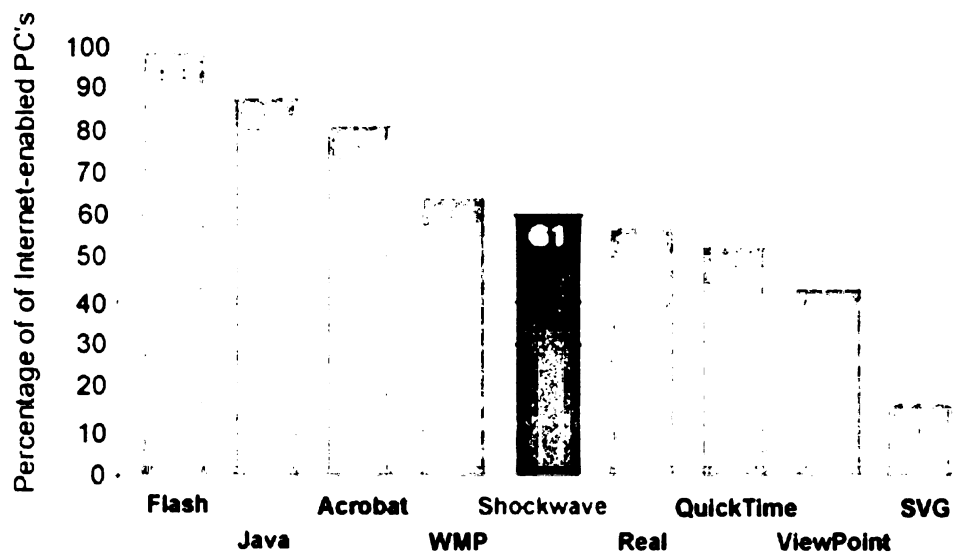
NPD Online Survey of plug-in penetration – March 2004: from Macromedia.com

Choosing the 2D Commercial Website

Before any development was to be done on the production, there were few details that needed to be thought out first. The first detail was determining what existing 2D website was going to be used. Because the 3D website was going to be based off of the existing 2D website, this site needed to be clarified, with the desired content in mind as well as the desired scale of the production in mind. To further explain, most web users like to go to certain websites on a daily basis. They often have a list of bookmarks that they might cycle through daily, looking for any new articles or publications that have just been published. These are websites that usually have a large volume of information and are constantly updated periodically. Some examples might be online newspapers like The New York Times or USA Today, or online informational technology websites like TechWeb[8] or Slashdot[9].

Initially, these were the type of websites that were targeted for use in this production because they have a high amount of traffic. However, the problem with the sites mentioned above is that their range of content was just too broad and impractical to use in a full-scale 3D environment. Why is this so? Unlike 2D based content, 3D based content has to be more visually descriptive to the user in order for the environment to make sense when the user is navigating through it.

To elaborate further, links placed within a 2D interface are usually represented by text, a button or a graphic and are almost constantly in sight at all times and do not move (unless the user has to scroll to get them within site). Interactive content within a 3D environment can be anywhere within a 360 degree viewing area. This means that some information will not be in sight and will take interaction by the user in order to bring the

content within sight. These areas can almost be compared to the 'blind spots' when looking into a car's side view or rear view mirrors. Serving as links within the 3D environment are models, and if there are a bunch of models placed randomly around a room, it would be extremely confusing to the user when they are navigating through the environment. So when designing a three-dimensional environment, the proper separation and organization of the interactive content (or models) is key, and if there is a monumental amount of content, that means that the overall size of the environment would have to be very large in order to display all of the content properly. For instance, if there was a section of USA Today pertaining to foreign headlines, an entire 3D section would have to be designed and implemented in order for it to make more visual sense to the user. The same would go for other sections or genres such as sports, local news, business, and so on. An environment representing all of these sections would be extremely spacious and complex.

Keeping these aspects in mind, there were a couple informational websites that immediately came to mind: MLive.com and Green & White.com. What made both sites appealing was that the range of topics covered was narrower, the information presented was generally targeted toward a specific target audience, and like the other major online newspapers mentioned above, these two sites were still updated with new articles and publications on almost a daily basis. It also helped these two websites also placed a strong emphasis on a topic area that is extremely appealing to me: sports information. These two websites are described in more detail below.

➢ **MLive.com**

MLive.com is an online information site that deals with "Everything Michigan"[10].

Basically, any newspaper, broadcast station, radio station, or any other interested parties

in Michigan can become an affiliate of MLive.com. Once an affiliate, MLive.com will

take any articles, publications, or information produced by their affiliates a post them on

the MLive.com website. Now, even though it only dealt with content related to

Michigan, the entire website was still larger in stature and contained a wider range

sections than what was desired. So it was decided that if this website was to be used for

the production, only one section could be focused on for the design.

Another problem with using MLive.com is that there were a few key features that

I could not or was not planning on representing in the 3D environment. One such feature

that is used extensively by users accessing MLive.com is the forum. Although it would

have been possible to implement a forum into the website, it probably would have been

represented in 2D since forums require some sort of database language such as PHP or

ASP. The main goal was to keep all interactive content three-dimensional, so the forum

would not have been an option and was eliminated from consideration.

Another feature was the streaming Real Video content. Although it is possible to

stream Real Video using Macromedia Director, the streaming itself would hinder the

real-time performance of the production. Additionally, users would be required to

download the Real Player which, compared to other media players and plug-ins, does not

have as high of a penetration percentage amongst most computer users (see the previous

Figure 3 for the penetration rate of the Real media player among households). This

feature was never intended to be a focal point of the production, but is a focal point of

MLive.com. When all of this was considered, it was decided that MLive.com would not

be used for the production and that another website would have to be considered. The website that was ultimately used is described below.

> **Green & White.com**

Green & White.com[11] is a sports information site dedicated solely to Michigan State University athletics, and is actually run by the Lansing State Journal online[12]. Basically, the content focuses mostly on Michigan State Athletics, but it also has some limited links to other campus news and main headlines from Lansing State Journal online. Because the content is really targeted toward users interested in Michigan State athletics, and the range of topics covered is narrowed down, it made the website ideal to use for the production. Another nice aspect of this site is that, even though it is run by the Lansing State Journal, it has its own domain name, unlike MLive.com where the sports section is just an extension of the MLive.com domain. This may not seem like a big deal, but to some users, it makes navigating easier.

The main focal points of Green & White.com that were represented within the 3D interface were the main headlines and articles from sport, rosters for each sport, the schedule/results from past seasons for each sport, picture galleries, articles from the Lansing State Journal columnists', recruiting headlines, calendar entries of sporting events, links to the sponsors for the Lansing State Journal, links to the official websites of the other schools in the Big Ten conference, and contact information. Once it had been determined that Green & White was going to be used for the production, the next step was to think of a metaphor or theme of 3D interface and environment.

<u>Deciding on a Theme</u>

Before constructing the actual scene, a theme for the 3D environment needed to be established. In other words, the environment needs to be based on a metaphor. I have always had strong interest in sports related topics and issues. Sports have been a passion of mine for many years now, and eventually, I would like to start a career within the sports entertainment industry. Because of this interest and familiarity, it made the brainstorming process much easier when trying to think of a theme or metaphor for Green & White.com.

Why does the environment need a theme? As stated previously, the environment has to be extremely visually descriptive and organized in a way that users will be able to learn or get a sense of where a section is. For example, take four rooms developed equal in size and visual appearance, but meant to showcase different content. If clickable models were placed in each room, each sharing similar visual appearances to one another, but each producing different actions when clicked, the user could have trouble recalling what model was where and what model did what. This would make navigating around such an environment more tedious to the user. With a traditional 2D site, it is different because most clickable content is represented by text, which is much more definitive.

There were initially a few ideas under consideration for the theme of the production. The first idea was to base the environment on the set of a television broadcast studio, such as something similar to ESPN's Sports Center. The user would be able to walk around to different monitors to view headlines and content, and they would also be able to interact with commentators on the set.

The second idea was to base the environment on a café setting, where the user can walk to a specific area and pick up virtual newspapers related to each sport. The problem with this system is that it would be in-practical to have a newspaper for each and every headline. It would also end up feeling somewhat unrealistic because the newspapers would have to be spread around the environment in a deliberate fashion, and most likely plastered against flat surfaces instead of being placed loosely and realistically around the environment. Besides, most café's don't have any association to sports whatsoever, so the entire theme would be a stretch.

The third idea for the environment was to create something similar to a "Hall of Fame" setting, where users can navigate to different areas of the environment and interact with objects situated in modeled trophy cases and informational booths. This did not seem like a bad idea initially, but in retrospect, it would have been difficult to try to associate trophies and other objects usually found in a Hall of Fame setting with articles, rosters, and other dynamic content found on Green & White.com.

The final idea was to use the concept of a locker room setting. Within this setting, the user could navigate to locker rooms representing each sport, and then click on bulletin board or white-board panels to bring up the latest articles and publications related to that sport. What was also nice about this concept is that the setting would be exclusively related to sports, where as the settings for the café and the studio could be used for just about any type of content.

It was difficult to decide what type of theme would be used for the production. It ultimately came down to the broadcast studio concept and the locker room concept. In the end though, it was decided that the locker room concept would probably work out the

best, but only because I was able to get in contact with a representative from the Michigan State University athletic department, who sent me photos of some of the official locker rooms at various Michigan State's athletic facilities. Having these photos would make it much easier to create textures for the scene, as well helping to provide an idea of the overall organization and placement of objects within a locker room. Figure 4 and Figure 5 below are a couple samples of those images received.

Figure 4

The MSU Men's Basketball locker room

Figure 5

A close-up of a MSU Men's Basketball locker stall

As previously stated, my objective is to create a functional, efficient website that will utilize 3D technology for navigation and to display content, and then test its functionality and practicality by subjecting it to user testing. This would ultimately help to determine if 3D technology would be a viable alternative to 2D technology in the production and development of web sites. Once the 2D website was chosen and the theme/metaphor was decided upon, it was time to move on to the development stage. The first part of the development was creating the virtual environment in 3D Studio Max, and the second part of development was implementing the environment into a clickable interface using Macromedia Director. Details and the thought process involved during the design process are described in more detail in the following sections.

Designing With 3D Studio Max

Even though there are two parts to the development stage, it was not as if the entire scene was designed in 3D Studio Max first, and then shipped to Macromedia Director for the implementation process. The designing of the environment actually took place in smaller increments at a time. Not every idea or concept works out the way it is intended to during development. If the entire scene was developed in 3D Studio Max and then brought into Macromedia Director, what would happen if there was some major aspect of the design caused problems when it came time to add interaction in Director? It would have to be brought back into 3D Studio Max to be fixed, and when a scene is

rather complex, even the most simple re-designs will have some effect on other objects designed in the scene. Often times, those other objects will also have to be redesigned or their placement will have to be changed. All of this adds more time on to the development process, so to avoid these occurrences, small portions of the environment were designed and then sent to Director to be tested in order to make sure they would fit into the concept. In all, there were approximately 21 different 3D Studio Max Files (.MAX extension) and approximately 10 different Macromedia Director Files (.DIR extension) that resulted from this process of trial and error.

➤ Organization of the Scene

The first step of the design process was determining the organization of the scene, thinking mainly about where each section and/or sport will be represented, and the placement of the objects within that section. As stated previously, careful consideration has to be made when determining the organization of the scene and the placement of objects within the scene in order for the environment to make sense to the user. To help determine this, an analysis of the organization of the 2D commercial website was needed. The two aspects that were focused on were the organization of the main navigation bar and the structure of the cover pages for each section or sport. Figure 6 below is a screen capture of the navigation bar from Green & White.com.

Figure 6

Cover	Football	Basketball	Ice Hockey	Men's	Women's	Recruiting	Fans	Contact Us

Screen capture of the main navigation bar from Green & White.com
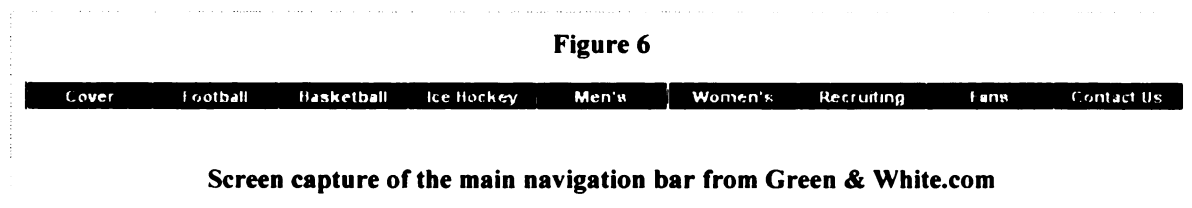
Initially after looking at the organization of the navigation bar, the idea was to create rooms for each button within the navigation bar, with the exception of the "Recruiting" and "Contact Us" button. These two buttons could be represented within another section and did not require an entire room. The "Cover" button takes the web user to the home page of Green & White.com, the "Fans" button takes the web user to a section where they can download wallpapers and view headlines pertaining to other news around Michigan State University, and all the other buttons take the user to the desired section related to that sport. Details of the design process for each room are described in the following sections.

- **The Main Room**

The development process of the 3D environment kicked off with the design of the main room, which represented the "Cover" button of the navigation bar and home page of Green & White.com. After looking at the home page of Green & White.com, a list was compiled of features and/or items that would be represented within the Main Room of the 3D environment. These included the four main headlines, the columnist section, the MSU Sports Calendar, and the table with links to all of the official websites of all the schools within the Big Ten conference. There were a variety of other features and links on the home page, but most of these where headlines that did not related directly to Michigan State Athletics, or they were multimedia features that could not be represented.

In some ways, the Main Room had to have its own theme because it was not exactly a locker room, but it still had content that had to be tied into the overall concept of the locker room them. How could this room be represented? Some sports facilities

have lobbies or rooms next to locker rooms where the media can wait outside until summoned in the locker room. Some of these lobbies can also be open to the general public, and often showcase trophy cases, bulletin boards with news and other postings, and other various items situated around the room such as statues, flags, and so on. This is how the Main Room would be represented. Now the focus turned to how each of the features from Green & White.com would be represented.

Figure 7

Spartan News

Fourth prep player verbally commits for '05
Southfield defensive back Ross Weaver has wanted to play football at Michigan State since his high school playing days started. (read more) - Published 2004-08-04

MSU sports digest
(read more) - Published 2004-08-04

Third verbal commitment brings speed
Michigan State's third verbal commitment for the 2005 football recruiting class brings a good dose of speed and size with him. (read more) - Published 2004-08-03

MSU Sports
(read more) - Published 2004-08-01

Screen Capture of the Main Headline section from the Green & White.com home page

Figure 8

Columnist

Schulz: Area grad 1st winner of Gross scholar ship

Past columns
tschutz@isj.com

Screen capture of the Columnist section from Green & White.com home page.

Figure 9

MSU Sports Calendar

August - September						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
			4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4

Screen capture of the Calendar Graphic from Green & White.com home page.

Some of the items generally found on bulletin boards include posters, advertisements, calendars of events and things of that nature, so it seem logical that the main headlines, calendar of MSU events, and columnist section from Green & White.com be represented in a similar fashion. Figure 7, Figure 8, and Figure 9 above

are screen captures of these three features. The next step was to determine how many bulletin boards would be used, what would be displayed on each bulletin board, and the appearance and placement of the bulletin boards. It was initially proposed that the main headlines, calendar of MSU events, and columnist section would have their own board and these would be placed against different walls around the room. However, this would meant that in order for the user to access this information, they would have to travel to each section, which didn't seem practical considering the amount of information displayed on each board would be rather minuscule. Instead, these items were all placed on one board or display labeled the "Information Board", with each item or panel being clickable. Some facilities have similar boards that display a variety of information, and are located in a central location instead of mounted against walls or other flat surfaces. Figure 10 below shows the design of the information board within in Main Room.

Figure 10

The "Information Board" designed for the Main Room

The other items on Green & White.com represented within the Main Room of the 3D scene included contact information, sponsors, and the links to the official websites of each school within the Big Ten Conference. When to web user clicks on the "Contact Us" button within the navigation bar on the Green & White website, it takes them to a page with all sorts of contact information. There is also a "Contact Us" link at the bottom of every page within Green & White.com, which is common on most websites. Instead of representing this on the main information board, this information was made accessible by navigating to a table within the Main Room and clicking on a flat panel monitor sitting on top of the table, displaying "Contact US" on its screen. The idea was to simulate an instance where, if the user wanted to contact the website by email, they could click on the computer flat panel and it would bring up information on how to contact Green & White by email, as well as other by other means. Figure 11 below shows the computer workstation designed within the Main Room. The radio that also appears within this image will be talked about at a later time.

Figure 11

The "Contact Us" computer station designed for the Main Room

Every commercial website typically has a list of sponsors that are represented on a specific page, or an area site-wide where graphics of each sponsor are placed. The sponsors on Green &White .com are displayed as graphics, the main sponsor being placed at the top within the Green & White.com banner, and the other sponsors being places at the bottom-left of the page. Within the Main Room of the 3D scene, these sponsors were represented within a smaller bulletin board located on one of the walls to the left of the Main Information Board, the main sponsor being the first sponsor at the top. Figure 12 below shows the "Sponsors" board designed within the Main Room.

Figure 12

The "Sponsors" bulletin board designed for the Main Room

The last item from Green & White.com that was represented within the Main Room of the scene was the table with links to the official websites of all the schools within the Big Ten conference. At first, it was difficult to think how these would be represented within the scene. But then it occurred that all of these schools have some type of mascot or flag, so the idea was to make a flag for each one of the schools within

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the conference and place them on one of the walls. This would make it easy for the user to identify what they were there for, as well as providing an aesthetically pleasing way to display all of the links instead of putting them within a bulletin board similar to the others already within the scene. Figure 13 shows the wall of the Main Room where the flags where placed, representing each school of the Big Ten Conference.

Figure 13

Wall within the Main Room where the flags were placed, representing each room of the Big Ten Conference

Once the Main Room of the 3D scene was organized, it was time to move on to the design and organization of the locker rooms. Figure 14 on the next page displays the wire frame view of the finished Main Room and Figure 15 displays the smooth, textured view of the Main Room.

Figure 14
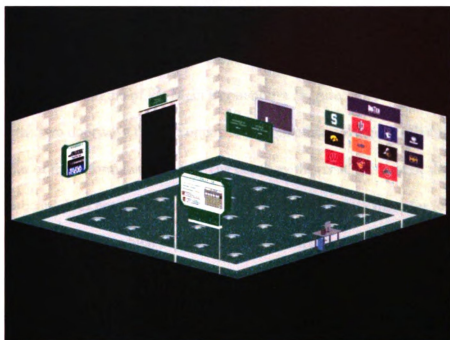
Smooth, textured view of the Main Room from the designed 3D scene.

Figure 15
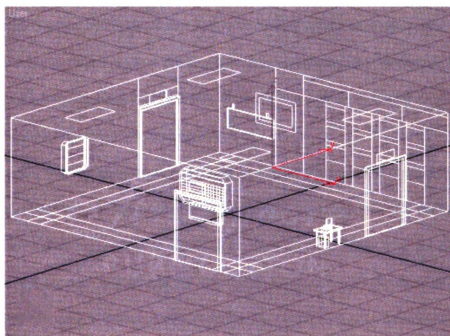
Wire-frame view of the Main Room from the designed 3D scene.

- **Locker Rooms**

As stated previously, locker rooms would be designed representing each button on the navigation bar, with the exception of the "Fans" and "Contact Us" button. However, if you look at the wire-frame of the Main Room above (Figure 15), there are only three doorways: the two doorways that are opposite of each other another one that is slightly offset in front of the Information Board. The doorway that is set in front of the information board does not actually work as a doorway and is only there for looks. That leaves only two doorways, which are supposed to branch into the locker rooms.

After some thought, it was decided that it would not be best to create locker rooms after each one of the buttons for different reasons. One reason is that environment would be way too large. There would be six different locker rooms, which would make navigating around the environment very time consuming to the user. In order to decrease the time it takes the user to access information for this production, the environment had to be smaller in stature. The optimal size had to be limited to two or three rooms, with interactive content placed in close proximity. Although it may take more time to navigate through than a traditional 2D site, the hope was that users would find the time to navigate through the environment tolerable.

In order to make this happen, the organization of the rooms in comparison with the navigation bar buttons had to be a little different. The organization of the navigation bar from Green & White.com is constructed in a way that the three most visited sport sections have there own button, and the other sport sections are displayed under the "Men's" and "Women's" buttons, which activate drop-down menus when the mouse rolls over them. But ultimately, all the content within Green & White.com basically breaks

down into two categories: men's and women's sports, so it was decided that only two locker rooms would need to be developed for the production.

The next step was deciding how to lay out each section (or sport) within the room. Initially, the concept was to develop a huge room, and section off portions of the room to represent each sport. Again, this environment would have been way too large and the thought was to make it function similar to a 2D website, where the most trafficked links would be more visible and more accessible. That's exactly how each locker room ended up being constructed. For the men's locker room, the basketball, football, and hockey sections were given their own section, and all the other sports were put into another section. The women's locker room was constructed in the same way with the basketball, volleyball, and softball sections receiving their own wall, and all the other sports were put into another section. In addition, both the men's and women's locker rooms had a recruiting section and a section for photos.

As far as the shape of the rooms is concerned, originally the idea was to use four-sided rooms for the locker rooms, much like how the Main Room was constructed. But because there were more than four sections that needed to be represented, the shape of the room needed to be different. Ultimately, hexagonal shaped rooms were created, with each section having its own wall. The photo wall was placed opposite of the doorway, which was nice because the photos are the first thing seen when the user enters the room, and the recruiting section was placed on the wall with the doorway entrance/exit. All the other sports sections were placed around the remaining walls. Figure 16 below shows the organization of the men's locker room, which is practically the same as the women's locker room.

Figure 16
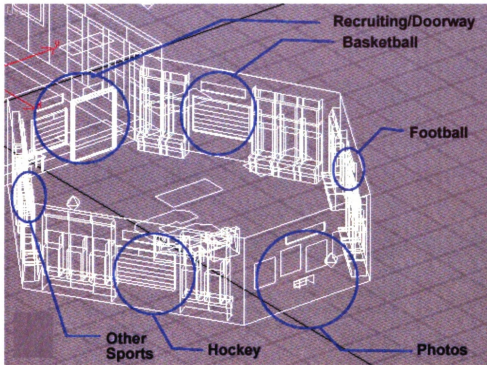
Wire-frame view of the Men's Locker Room, with a labeling of the sections

Within each sports section of both the men's and women's locker rooms are three items: representations of a whiteboard, lockers, and a sign displaying what section it is. As a means to display the latest headlines for each section, originally the idea was to have a standing A-Frame and poster located somewhere within the section. However, there where a couple other things that also needed to be represented somewhere, and space within the poster area was too limited to display the items properly. These included a list of the current roster for each sport and the schedule/results of the current season. Both can be accessed on Green & White.com by either using the links in the drop-down menus (Figure 17) or by clicking on the links in the upper left-hand side of the page (Figure 18). There are some buttons, however, that do not have the option of selecting the roster or

schedule/results from the drop-down, so the in-line links within the page have to be used
in order to access the information.

Figure 17   **Figure 18**
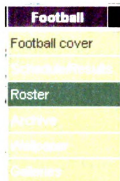
Screen capture of a
drop-down menu
from Green &
White.com

Screen capture of the roster and
schedule/results links for pages
of Green & White.com

Instead of using A-Frame and poster concept, an alternative was thought of,
which was to use a white-board (Figure 19) type representation. Within the white board
there are 4 clickable panels displaying latest headlines pertaining to that sport, a
schedule/results panel, and a roster panel. The 4 panels displaying the headlines were of
higher priority than the roster and schedule/results panel, so they were place in the upper
left-hand corner of each white board. The roster panel was placed in the upper right-hand
corner of the whiteboard, and the schedule results panel was placed at the bottom of the
whiteboard below the main headlines. There was one exception to the placement of these
panels within one of the sections. For the "Other Sports" section, the rosters and the
schedules were not compiled for each of the sports represented in the section, so these
had to be replaced with other items. Since only the latest headlines out of the entire pool
of sports represented would be posted, not every sport was going to be represented on the

whiteboard, so a "What Sports" panel was created and inserted in place of the "Roster" panel. When the user clicks on this panel, a list comes up displaying what other sports are covered within the section. If the user does not see a headline from one of these sports on the whiteboard, there probably have not been any new postings for that particular sport in some time. As far as the schedule/results panel is concerned, this was replaced with another headline panel, which brought the count for the number of headlines displayed to 5 instead of 4. Figure 19 below shows the standard organization of a whiteboard, and Figure 20 shows the organization of a whiteboard for one of the two "Other" sports sections.

Figure 19

The Women's Softball whiteboard with standard organization of panels

Figure 20
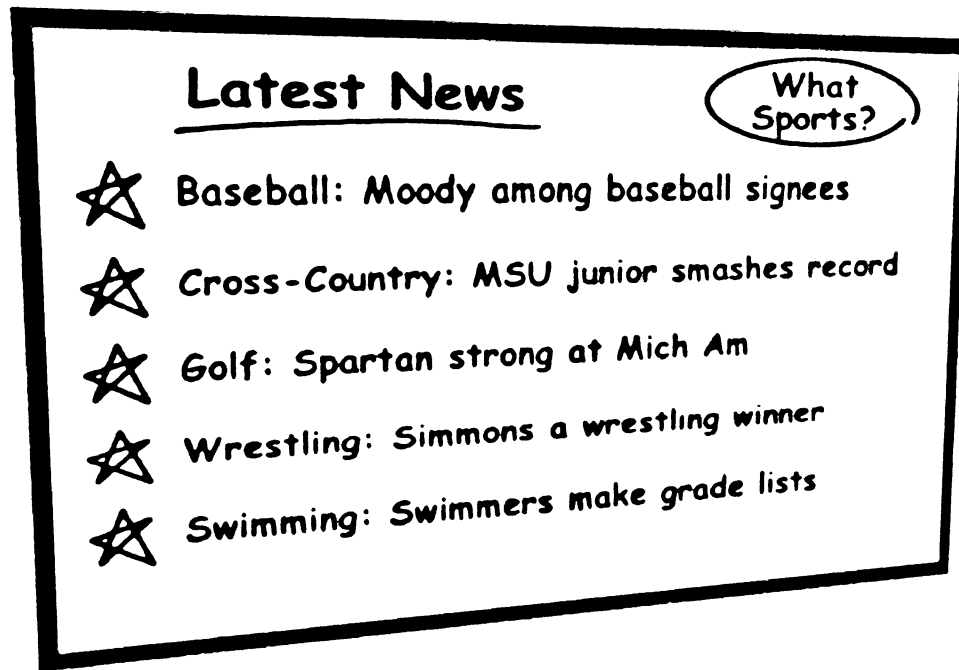
The "Other Sports" whiteboard from the Men's Locker Room with alternate organization.

On a couple final notes, regarding the whiteboards, the text appearance for the panels on each board was deliberately designed using the Comic Sans Serif font. This was done so that it gave the appearance that it was written by hand, like how coaches might write on a whiteboard when diagramming plays, putting up motivational quotes, or any other thing coaches might write on a whiteboard. It may look a little more un-organized in real-life, but the font still adds a nice hand-written touch. Additionally, the white board within the "Recruiting" section was simplified, only displaying the latest recruiting headlines, with the roster area and schedule/results area being cut out of the design.

The other two items within each sports section of the locker rooms are the sign displaying what section it is and the actual lockers, both serving as helpers to make it easier for the user to determine what section they are in. Signs representing each section display text of what the section is and they also have some sort of graphical symbol that correlates to that particular section. The lockers for each section also have their own distinctive design, with pictures of various men's sports displayed at the top of the each locker, as well as uniforms or jerseys displayed within the inner cavity of each locker. The uniforms or jerseys for each section represent that specific section or sport and, although they are not displayed in every locker. See Figure 21 below, which showcases the Men's Basketball section of the Men's Locker Room.

Figure 21
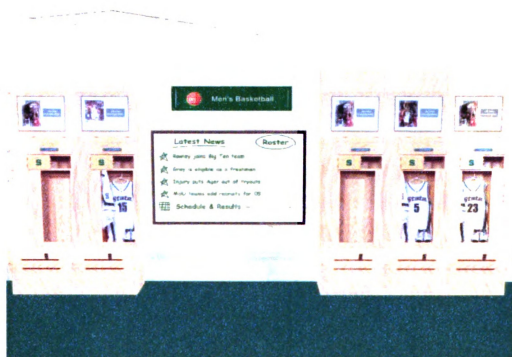
View of the Men's Basketball section of the Men's Locker Room.

The last section within each locker room that I would like to talk about is the "Men's Photos & Pictures" section. On Green & White.com, there are multiple links that the user can click on to go the "Galleries Archive" page. These links can either be accessed within drop-down menus (where applicable) or within the cover pages of each sport on the upper left-hand side (see Figure 17 and Figure 18). Within the galleries archive page, there are a variety of links that, when clicked, open up the Green & White Photo Gallery viewer in a new JavaScript window. The user can cycle through the images by clicking on the number links below the image (Figure 22).

Figure 22
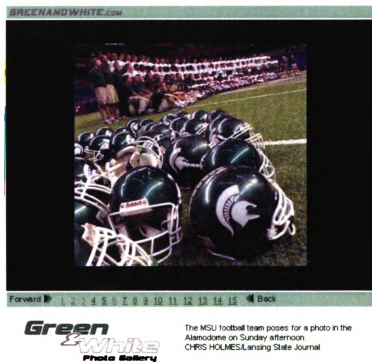
**Photo Gallery viewer from Green & White.com, featuring
football pictures from the Alamo Bowl, 2004**

To represent these photos within the 3D scene, four photo panels were placed against the wall within the photo section of each locker room, each displaying a different

picture frame-type photo. Below these photos, a podium or shelf was designed with a clickable representation of a photo album on top. Originally, it was intended that when the user clicked on the photo album panel, a photo gallery viewer similar to the one found on Green & White.com would open up in a new browser window. This photo gallery was completely HTML and was actually implemented into the project. The problem with this concept, as stated before, was that the intention was to try to keep all clickable content within the production three dimensional. So the focus turned to trying to find another way to display the photos.

Figure 23

"Men's Photos & Pictures" wall with "Stop Slideshow" sign appearing.

Ultimately, the end result was this: when the user clicks on the photo album panel, the photos on the wall change in a slide-show type manner. Additionally, there was a sign designed and mounted on the face of the shelf that says "Stop Slide Show" (Figure 23 above). When the slide-show is not turned on, this sign is not visible, but when the slide-show is activated, the sign becomes visible and the user has the option of clicking on the sign to stop the slide-show. More details of this development can be found in the "Implementation with Director" section of this report.

➤ Other Helpers and Objects

Within the environment, there are few other objects that were created. Within the Main Room, signs were created that label what doorways lead to each locker room and set of matching chairs, along with an end-table, were created within both locker rooms. The primary sign within the Main Room was placed just behind the information board and hangs down from the ceiling, displaying directional arrows and text telling the user what way to take to get to the men's and women's locker rooms (Figure 24). Additionally, signs were placed above each doorway labeling what locker room the user is entering (Figure 25).

Figure 24   **Figure 25**
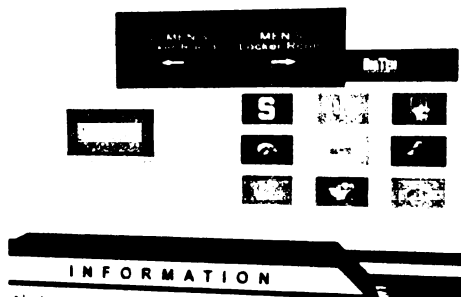
Directional sign for the main room   Doorway sign for the Men's locker room
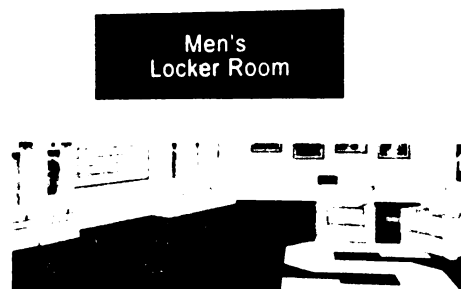
The chairs and tables were created to fill a void within the middle area of each locker room (Figure 26). Many locker rooms in real-life typically have lounge chairs that players can sit down, often just to talk to other teammates and socialize. There are also typically items like TV's, media equipment, game consoles and so on that players can utilize to pass the time or study up on the opposition. Because space was limited against the walls, the location of these items would have to be within the center of the locker

room, which probably would have appeared awkward, so they were left out of the design.

But in all, the chairs and tables are only there for looks, and they help to fill the void left

in the middle of room, so their purpose has been served.

Figure 26

Chairs and table featured in both locker rooms

> **Lighting the scene**

All scenes that are designed with 3D Studio Max start out with one default

ambient light, which illuminates the entire scene. Initially the scene was designed with

the intention of only having this one light, but after looking at a rendered image of the

entire scene, it was apparent the scene needed more illumination. The default light also

was not adjustable and was in-capable of emitting shadows, so four omni-directional

lights were placed in the scene. Simply one omni-directional light would not be enough

because there would be way too many shadows emitted from certain objects, depending

on where the light was placed. Within the finished scene, however, the ability to cast

shadows was turned off because casting shadows within Macromedia Director requires

more processing time and power. When Director has to draw every detail of these shadows as the user moves through the environment, it hinders the performance of the application. This will be elaborated upon in the "Performance Optimization" section of "Implementation with Director". Figure 27 below is a wire-frame top view of the environment, showcasing the placement of the four lights.

Figure 27
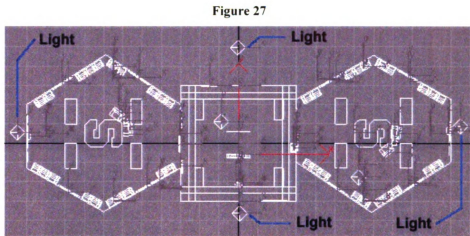
Wire-frame top view of the environment, showcasing light placement

> **Thinking of Low-Poly**

Every model within the scene was designed with an emphasis of keeping the poly-count of entire scene low, which means the amount of faces each object possessed was as minimal as possible. This also has a direct correlation to performance optimization. Most of the clickable objects within the scene are strictly planes with textures mapped to the face to face of the object. Any objects that were designed with more than one face were cut down in a way that, if a face was not going to be visible to the user when navigating through environment, it was eliminated or deleted. Since the user is not able to see the back, bottom, and top faces of many of the objects, the faces of these objects were often eliminated. When navigating through the environment, any face

or faces that Director does not have to draw is a plus, and benefits performance. The lower number of polygons also keeps the files size smaller. Objects such as the lockers, information board, computer station and so on were had faces eliminated. Figure 28 below is an example of a set of lockers that had faces eliminated.

Men's Hockey lockers, with top faces eliminated

➢ **Texture Creation**

Every panel and/or object within the environment had their own unique texture mapped to it. With the exception of the panels, most textures were created by finding images on the web that best fit what I had in mind for the design of the objects, and then editing them with Macromedia Fireworks in a way that they would look realistic when mapped to the object. By using the UVW mapping modifier in 3D Studio Max, the textures could be mapped in either a box or plane-type fashion (Figure 29). There are also other methods to UVW map a texture to an object such as in spherical and

cylindrical-type fashions, but there were to no objects within the scene that resembled

these types of primitives. The ceiling and floors of each rooms also had carpeting textures

that had to be tiled using the UVW mapping modifier because the textures initially

appeared to blurry when stretched over the objects.

Figure 29
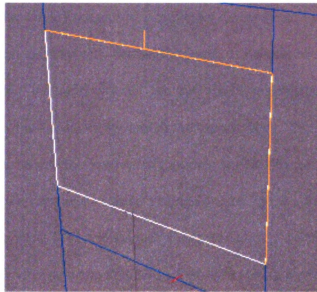
**Plane UVW map applied to one of the flags. The
orange border represents the UVW map**

For each one of the panels, simple textures were created from scratch using

Macromedia Director (Figure 30). Originally the intent was to map these textures to

panels by using Director itself. Director has the capability to map textures contained

within the cast libraries to models within the scene. Additionally, this would have made

the headlines more dynamic. If any changes needed to be made to any headlines, this

could be done solely in Director, without having to use 3D Studio Max to alter the

textures and then export and import the altered W3D file into Director. However, there

were a few problems that came up when experimenting with mapping these textures in

Director. One problem was that textures always looked a little distorted no matter how much the UVW map coordinates were tweaked. The visibility and clarity of the headlines had to be one of the top priorities, so any loss of clarity was un-acceptable. The other problem related to the transparency of the white background within the headline textures. Even though the white background was part of the image, when mapped to a panel, the while background completely disappeared, leaving only the text: You could see the text and the walls behind the panel. It was almost as if the white background was part of the alpha channel, but this was impossible because the graphic image was a JPEG, which does not support alpha transparency. Ultimately, these problems went unsolved and this method of mapping textures to panels was not used. Besides, in order to map textures to objects using Director, quite a few lines of coded are needed to make it happen. With the amount of panels designed in this production, having to map a texture to every one using this method would have been rather impractical.

Figure 30

☆ Coach reaches top of mountain
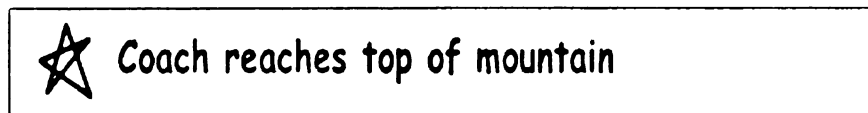
Texture map for one of the men's football headline panels.

➤ **Camera and "Dummy" Placement**

The last few items in the environment that should be addressed before moving on to the "Implementation with Director" stage are the camera, dummy object and safe plane objects. A camera was created for the scene and placed directly in from of the Information Board within Main Room. The camera represents where the user will virtually start out within the 3D environment when Shockwave file is played. When

navigating through the environment, the dummy object moves and the camera follows closely behind the dummy as it moves through the environment, rather than simply the camera itself moving (Figure 31). When running the simulation, the dummy object actually is invisible, which helps to give the user a first-person perspective. This method was used in the event that if an avatar was ever added to the scene, the avatar would simply replace the dummy within the scene as the object the camera would follow.

Figure 31
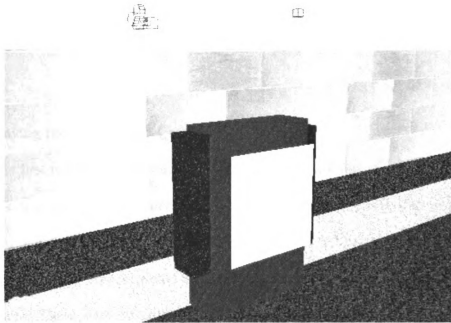
Camera, dummy object, and safe-plane from the 3D scene

As you can see from the image above, the dummy object has two boxes attached to it, along with a plane placed directly in front of it. These objects were specifically created with collision detection in mind, which will be described in further detail within the next section. This concludes the description of 3D Studio Max design process.

Implementation with Director

The next phase was to implement this environment into a 3D interactive application and develop the graphical interface using Macromedia Director. Elements of interaction implemented within the scene included the addition of camera and dummy movement, roll-over effects when mouse cursor moves over an interactive object, the capability to start and stop the photo slide show, and ability to use back and forward buttons to cycle through previous articles and/or camera positions after an object had been clicked on. Details of these developments are documented in the following sections.

> **Displaying the Articles and Content**

The first major obstacle was to determine how the articles and clickable content would be displayed within the interface. Although it would have been nice to display every thing as three-dimensional, because the user needed to be able to scroll through some the articles, this content would have to be displayed in some type of scrollable 2D viewing area. There were two different ideas on how this would be done.

The first idea was to have the scrollable 2D viewing area pop-up in a window over the top of interface. The user would be able scroll through the article and then close out the window by pressing an exit-out button and resume navigation within the environment. The second idea was to place the scrollable 2D viewing area next to the W3D sprite. This area would be stationary, meaning it does not need to be closed. Whenever another object is clicked on, it simply replaces what was previously displayed in the 2D viewing area.

In order to determine which method would be used, two simplified interfaces were developed using these two different concepts, and I had 5 of my close friends test out each method and give me feedback as to which method they preferred. 3 out of the 5 users said they preferred the second method (stationary) over the first method (pop-up) for a couple different reasons. One reason mentioned was that the pop-up method felt too much like, pretty obvious here, a pop-up. Some web users have a bad reaction when any type of window pops up while they are surfing the web, so naturally, an association between pop-ups and this method might be made. Another reason mentioned was that the stationary method did not break the "flow", meaning the environment was still visible and active. The user could immediately resume interacting with the environment without having to click to close out any windows. The only disadvantage mentioned, pertaining to the stationary method, was that the overall width of the interface was too wide and the 2D viewing area was too narrow. Based on the feedback, ultimately it was decided that the stationary method would be used.

➢ Designing the Web Interface and Overlay

After deciding on how articles were going to be displayed, the next step involved creating the web interface that would house the W3D and 2D viewing area. This was done using both Macromedia Fireworks and Director. First, the entire interface was designed and laid out as one entire graphic in Fireworks, with a screen capture of the 3D scene placed on middle left-hand side in order to help me determine the placement and size of the 3D and 2D viewing areas. Then, the screen capture was removed, which left only the transparent background in that area (Figure 32).

Figure 32
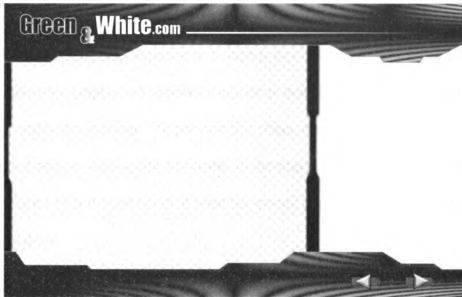
Graphic of the entire interface from Fireworks, with transparent area

Since there are many web users who can still only obtain a resolution of no more than 800 X 600 on their computer monitors, the size of the interface was designed to keep this in mind. The entire interfaced ended up at a size of 800 X 510: the more viewing area allocated for the 3D viewing area, the better. Once the final size was determined, the interface was then "sliced" into four different sections: The top graphic, bottom graphic, 2D viewing area graphic (the area on the right-hand side in Figure 32), and the overlay graphic (the checkered 3D viewing area). The checkered (or alpha transparency) area represents the area of the W3D sprite that is visible when the movie is playing. These slices were then exported in a .PNG format and imported into Director. The reason for using the .PNG format is that it supports alpha transparency, which is needed for the overlay graphic, and the quality is higher than say a .GIF because it's 32 bit.

The only objects that can appear over the top of the W3D sprite as the movie is playing are called overlays. In order to make the 3D viewing area less "boxy" looking, I wanted the 3D viewing area to appear as though it was underneath the jagged edges of the top and bottom graphics, or to make it appear as though the 3D viewing area was embedded within the interface. To produce this effect, the overlay graphic was implemented and the W3D sprite was scaled to the exact dimensions of the overlay graphic. Figure 33 is the end result of what the overall interface looked like after it was all said and done.

Figure 33
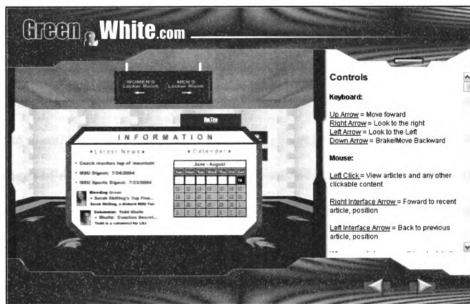
The overlay graphic of the W3D, which helps to produce the effect as though it is embedded within the interface.

The last element of the interface designed in Director was the introductory screen. When the movie is first opened, the user sees this screen first, which does not actually have that much to it. There is some text in the 3D viewing area that gives a short description about the experiment and mentions that all the articles and publications come

from Green & White.com. The controls are displayed on the right-hand side, and when the user is ready to proceed, they can simply click on a button located just below the description to initialize the scene and begin interacting with the environment.

> **Camera/Dummy Movement**

The camera is the user's portal to the world, providing the first-person perspective needed to make it realistic. As stated previously, the user does not control the camera directly. When navigating throughout the environment, they are actually controlling the invisible dummy object, and the camera simply follows the dummy object around.

Moving the object requires the use of the directional pad on the keyboard. The "UP" arrow moves the dummy forward through the scene, the "Down" arrow moves the dummy backwards, the "Right" arrow rotates the dummy clockwise, and the "Left" arrow rotates the dummy counterclockwise. Originally, there were different controls used in the initial stages of development. The up and down arrows functioned the same way, but the right and left arrows strafed the object right and left instead, and rotation was controlled by the mouse. If the user moved the mouse cursor right or left, away from the center of 3D viewing area but still inside, the dummy would rotate in the direction the mouse pointer was heading. This was a reasonable approach, but one annoying problem arose. If the user wanted to scroll through an article that was selected, they would have to move the mouse cursor over to the right hand side of the interface, which also caused the camera to rotate to the right. This might not sound like a big deal, but if the user wanted to view a bunch of articles, all of this added movement would get annoying after some time. Thus the previous method of movement described was used.

Another aspect focused on in development was the smoothness of the camera and dummy movement. With a minimal amount of coding, it is simple to move any object throughout the environment. However, the movements of these objects typically have an incremental-type feel. For instance, when moving in a forward direction, the start and stopping of the object may feel abrupt and unnatural. For this production, acceleration and deceleration were factored into the movement of the camera and dummy object. When the up arrow is pressed, the dummy accelerates until it reaches top speed. When the down arrow is pressed, the dummy decelerates until it reaches the minimum speed. The acceleration rate, deceleration rate, maximum speed, and minimum speed can all be adjusted to produce the desired effect. This method adds a great amount of flexibility when adjusting to make the movement as realistic as possible. It also factors into functionality of the collision detection for the scene, which is described next.

➤ Collision Detection

Once navigation of the environment was made possible, collision detection had to be implemented, which is how the movie determines if the dummy object makes contact with another model in the environment. There are two different ways to implement collision detection in Director. The first method is by using the built in "Collision Modifier" of Director. If I wanted to classify an object within the scene as an object that could be collided with, I could add the modifier to this object with a few lines of code. However, because there are so many models within the scene, using this method would have been rather in-practical because it would have to be applied to every one. Although I have never used this method, it has also been said that using the collision modifier can

drastically put a strain on performance. This is something that I wanted to avoid, so ultimately this method was not used.

The second method involves the use of "rays" to check for collision detection. An invisible ray, or multiple rays, can be cast from any model and towards any direction on the X, Y or Z axis. As an object with a ray attached moves around the environment, Director checks the list of models within the scene to determine if the object has made contact with any other models within the environment.

Figure 34
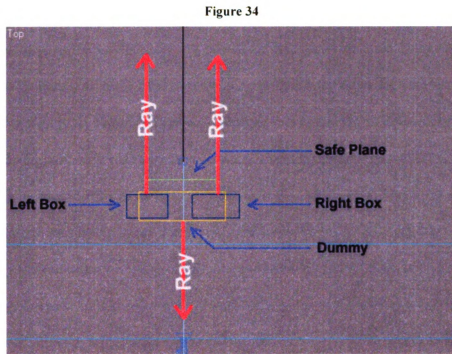
Top view of the dummy, left box, right box and safe plane, with rays shooting out along the z-axis

As stated previously, the dummy object has two other boxes attached to it on the right and left, and a safe plane was placed directly in front of the dummy. The two boxes attached to the dummy help to serve as the left and right boundaries for the dummy object as it moves throughout the environment. This was accomplished by shooting a ray along

the z-axis (forward direction) from each one of these boxes. If the rays make contact

with any other model within the scene, it brings the dummy object to a stop.

Additionally, another ray was shot behind the dummy along the z-axis, bringing it to a

stop if the user backs up and makes contact with an object. Figure 34 above is a top view

illustrating the placement of these rays along the z-axis.

The safe plane shown in Figure 34 functions slightly different. As the dummy

moves throughout the environment, the distance between the safe plane and the dummy

object will either increase or decrease depending on the speed. The faster the speed of

the dummy, the greater the distance will be. If the safe plane makes contact with another

model, it will attempt to deflect the dummy left or right away from the object instead of

bringing it to a stop. It determines when to deflect and when not do deflect based on the

distance between the safe plane and the dummy, along with the angle at which the safe

plane makes contact with a model. For instance, if the speed of the dummy is at its max

and the dummy does not make contact with a model straight on, it is very likely that it

will deflect instead of bringing the dummy to a standstill. This feature is very useful

because it helps to sustain movement. Without it, any contact the other arrays make with

other models would automatically cause the dummy to stop, which can make the

navigation feel less realistic.

➤ Triggering Roll-over Effects

To make it easier for the user to identify clickable panels or objects, roll-over

effects were implemented for all of the clickable content within the scene. These types of

effects resemble those commonly found on standard HTML web pages, where graphical

buttons and text may change when the mouse cursor rolls over the top of them. This was accomplished similarly in Director by changing the "specular shader" of clickable objects to a different color when the mouse cursor rolled over the top of them, and then changing it back to its original color after the mouse cursor left. Shaders actually define how the surface of a model reacts to light, and specifically, the specular shader controls how the surface of the model is highlighted[13]. It does not change a model's texture, but it does have some affect on how it looks. If a model's specular shader was changed to green, that model would appear to be highlighted in green.

Figure 35

Screen capture of the Information Board showcasing the roll-over effect

Determining what this color would for each model took some tweaking. The headline panels of each whiteboard are mostly white, so it was decided that the specular shader of the panels would probably look best with a color like blue (Figure 35). Other objects such as the Big Ten flags had darker textures using a variety of colors, so a white specular shader was used instead to make the change feel more noticeable. Additionally, the intensity of the specular shader color had to be adjusted down for some of the models

once active. Four lights are placed around the border of the environment and light emitted from these lights hits some models more directly than others. The more direct light a model receives, the more the intense the highlight is.

> ➢ **Article Swaps**

Within the 2D viewing area of the interface, the movie initially starts with a scrollable text member displaying how to navigate and interact with the environment. Once the user navigates through the environment and clicks on one of the objects or panels, this text member is swapped with another scrollable text member displaying pertinent information related to that object, such as an article or caption. For instance, if the panel displaying "Gray is eligible as a freshman" is clicked on, the current text member within the 2D viewing area is swapped with another text member displaying that article. In addition, a sound effect is played and a Flash movie located above the text member blinks on and off, signaling to the user that new information has been displayed in the 2D viewing area. See Figure 36 below.

Figure 36
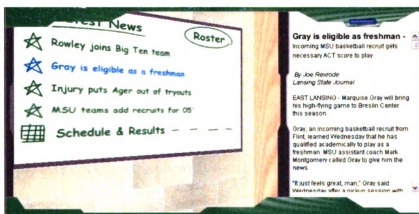
Roll-over and article swap for a men's basketball headline

Clickable objects such as the Big Ten Flags and the Sponsors function somewhat differently. When these objects are clicked on, another browser widow opens containing the web page representing these objects. JavaScript is used to control the overall size of the window when it opens, which was set to be re-sizable and to contain scroll bars, a menu bar, and a tool bar. Additionally, objects that trigger and external event like this also swap the text member within the 2D viewing area with a short caption displaying what has just been clicked on and cautioning the user that the browser may take some time to appear (Figure 37 and Figure 38 below). Similar captions are also triggered when the user clicks sectional signs above each whiteboard, such as the Men's Hockey section.

Figure 37

Figure 38

JavaScript pop-up window for Ohio State University, triggered from the Flag

External Browser Opening -

You are going to the official website of **Ohio State University**.

The browser may take some time to appear.

Captions within the 2D viewing area that displays where the user is going, triggered from the flag.

> **The Photo Slideshows**

When the user clicks on the photo album graphic, on the modeled shelves within the photo and picture sections of each locker room, it begins a photo slide-show. All four photos are swapped with other images every couple seconds or so. The stop slideshow

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sign will also appear and when clicked, the user can stop the slideshow at any time. Director retrieves these images from different cast libraries and each photo panel has its own library. This also creates some flexibility when determining what particular images will be swapped for a particular photo panel. For example, if I only wanted men's football pictures to be displayed in the first photo panel within the men's locker room, I would go to the cast library representing that library and I would insert only men's basketball photos. Figure 39 illustrates the cast libraries in Director used for this purpose, starting with the "mens_photos" library.

Figure 39
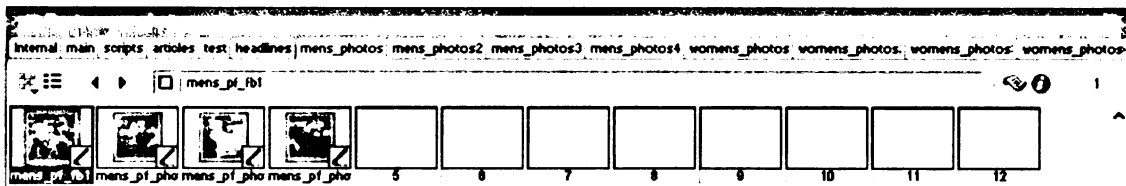
Screen capture of the cast libraries used for this production, the cast library shown being the library that the first men's photo panel uses to retrieve the other photos from.

➢ Implementing the Back and Forward Buttons

The last clickable objects implemented within the interface were the back and forward buttons located just below the 2D viewing area (Figure 40). When clicked, the back button displays the previous article within the 2D viewing area and moves the

dummy and camera back to the location where the user last clicked on an object or panel. Likewise for the forward button, returning to the article and dummy location before there was interaction with

Figure 40

Back and forward buttons

the back button. The idea was to make this function similarly to how the back and

forward buttons of a browser window function, which are utilized quite repetitively and often by most web users. This is accomplished in Director by using lists to record previous interactions. When the user clicks on an object or panel, Director identifies what the current article in the 2D viewing area is, and then adds this reference to a list. Additionally, the current world transform position of the dummy object (also referred to as the x, y, z coordinates) is recorded into a list. When the back and forward buttons are pressed, Director will refer to these lists to bring up the previous article or caption displayed in the 2D viewing, and will also return the user to the previous location of interaction. The user is able to press the back and forward buttons multiple times in order to return to the desired article/caption and location within the environment.

> **Performance Optimization**

Most of the techniques used to enhance performance optimization were already briefly touched upon in previous section of this report. These techniques included keeping the number of polygons (of faces) of each object at a minimum, keeping shadows emitted from lighting to a minimum, and using the arrays instead of the built in collision modifier for implementation of collision detection. All of these help to decrease any type of lag that might occur and enhances the performance of the application.

Another technique that was used, more out of necessity than being optional, was creating all the texture map sizes in some power of two. When the W3D is running and the user is navigating through the environment, all texture maps that do not have sizes in some power of two are automatically scaled to dimensions that meet the power of two standards. The reason for this being that the renderer of Director requires that all textures

be in some power of two.[14] These adjustments can drain processing power and slow the overall performance of the application. Additionally, as Paul Catanese states in his book "Director's Third Dimension", all textures should also be no larger than 512 X 512. It becomes a question as to whether the user's machine will be capable of displaying textures with dimensions larger than this.[15]

> **Publishing the Movie**

Once the performance of the application was optimized as much as possible, the final step was to publish the movie into a Shockwave file and HTML page. An HTML template with content loader and progress bar was selected under the publish settings, and the background color of the HTML page was set to a medium gray. Additionally, the box was checked asking whether browsing scripting was used (JavaScript pop-ups), and standard compression settings were used (Figure 41).

Figure 41
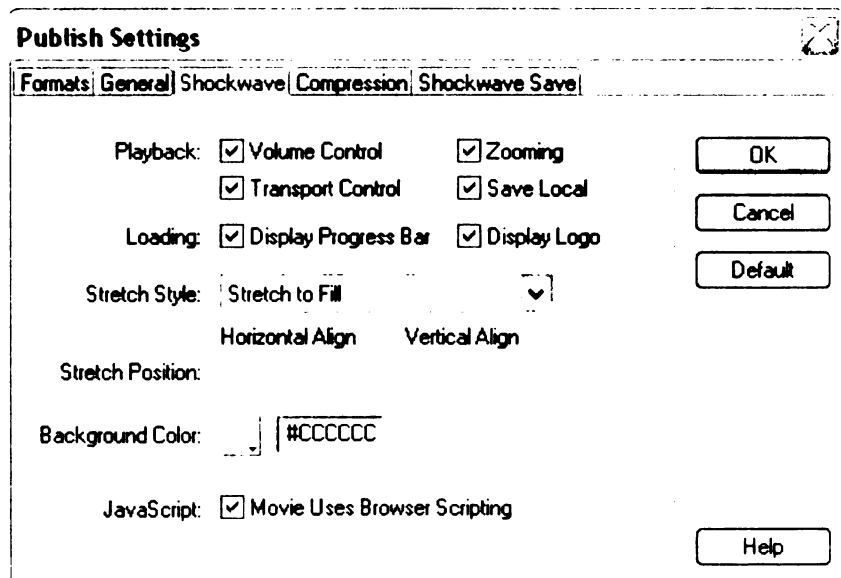
Publish settings used for the final shockwave movie

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Typically, larger movie files would be compressed more to enhance download optimization, but because the focus of this production was on 3D navigation, content display, and performance, optimizing the movie for download from the web was not a priority. Texture quality, clarity, and visibility were top priority, and compressing the movie a great deal would have affected these aspects more than what was desired.

The next phase of the production was to begin user testing in order to test its functionality and practicality compared to traditional 2D sites. This phase is described in more detail within the next section.

Once the development of the interface and website utilizing 3D technology was finished, the next step was to conduct research in order to see how subjects interacted with the site and its interface, in comparison to the Green & White.com commercial site. But before any research and testing was to be conducted, the subject population had to be identified and subjects had to be recruited and screened properly. Details of the subject population and recruiting process are described below.

Identifying the Subject Population

The subject population for this experiment included students enrolled at Michigan State University with at least basic computer and internet knowledge, and who have an interest in sports and like to follow current sports topics and headlines. This subject population may also have incidentally included women of childbearing age, low income persons, minorities, and individuals with HIV or AIDS. Overall, there were a total number of 10 subjects that participated in the experiment, with an ages ranging anywhere between 18 and 35.

➢ Justifying the Sample Size

The research conducted for this experiment was intended to provide a first look at the interactions and reactions of various users as they navigated through a 3D interface designed to distribute web content. Usability research, where the goal is to identify serious and minor problems with usability, often uses only 5 or 6 subjects and is believed to be able to identify 60% of the problems. The type of research conducted for this

experiment not only looks at usability, but also at user reactions and attitudes towards both the 2D interface and 3D interface. So instead, ten subjects were used as opposed to six in order generate a larger pool of reactions. All ten could have felt the same way about the 3D site, the majority could have felt the same, or reactions could have been mixed amongst the subjects.

➢ **Criteria for the Inclusion of Subjects**

The subject population for this experiment included students enrolled at Michigan State University with at least basic computer and internet knowledge, and who have an interest in sports and like to follow current sports topics and headlines. Two screening questions were used to determine whether subjects were qualified to be included within this subject population identified for this study. Subjects who responded that they used the web at least once a week to obtain news or statistics about various sports, and who also responded that they enjoyed using computers to browse the internet, were all candidates for inclusion within the study. The two questions asked are below.

✓ Question 1:

Do you use the web AT LEAST ONCE A WEEK to read news stories or statistics about professional sports? (If no, they were thanked and screening was ended. If yes, continued to the next question)

✓ Question 2:

Do you enjoy using computers to browse the internet? (If no, they were thanked and screening was ended. If yes, they were invited to be a part of the study).

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➤ Criteria for the Exclusion of Subjects

Based on the screening process described above, subjects who did not use the web at least once a week to obtain news or statistics about various sports, and those who responded that they did not enjoy using computers to browse the internet, were all excluded from consideration for participation within the study.

Recruiting Subjects

To recruit subjects, a convenience sample of students was taken based on peer and friendship networks. I served as the secondary investigator and was responsible for all initial contact made with potential subjects. I actually knew some of the volunteers because they had come from peer and friendship networks. However, the association was not formal – I was not an employer or a teacher or teaching assistant. So the participant rights were not threatened, nor was there coercion involved with the research. When initially contacting a potential subject, the candidate was politely asked a question, which is stated below.

> *"Would you like to sign up to participate in a research study comparing 2D and 3D web interfaces to online sports news and information for master thesis project? If you are interested, I can give you more information"*

Those students who were interested were told that "Participating in the project will take up to an hour of your time. We would meet in a room with a computer. You would be asked to explore two sports information web sites, one with a 3D interface, and one with a 2D interface, while a researcher observes and takes notes. Then you would complete a short survey about your reactions to the two sites. Does this sound like something you

would like to do?" If they said yes, the secondary investigator asked the two screening questions mentioned previously and if the interested participant qualified for the inclusion, he or she was shown a sign-up sheet. Once the interested participant picked a time slot and eventually arrived at the room specified by the secondary investigator during the screening process, the subject testing session commenced.

Overview of the Subject Testing Sessions

All research and testing was conducted in a controlled lab environment. Upon arrival, the subject was immediately presented with a consent form detailing what the experiment was about and any risks and benefits associated with participating in the experiment. Once the subject had signed and dated the consent form, they were asked to sit down at the computer workstation to begin the experiment. The secondary advisor was positioned behind the subject in another chair and took notes with a laptop during each stage of the experiment. All notes taken by the secondary advisor were logged in digital form using Microsoft Word and separate templates that were constructed and organized with the necessary categories, tasks, and questions required for each stage of the experimental process.

Research was conducted in three stages: The exploratory stage, the task performance stage, and the interview stage. The first stage was strictly exploratory and required the subject to freely explore both the 2D commercial website (Green & White.com) and the 3D experimental website, with the secondary investigator taking notes of the subject's interaction with both websites. During this entire process, the

subjects were also encouraged to "think aloud" any comments or suggestions they had when exploring both websites.

The second stage was task oriented and required the subject to perform a list of tasks compiled for each website, with the secondary investigator taking notes of the subject's interactions with each site as well as how the subject performed each task. These tasks were verbally relayed from the observer to the subject one at a time. Once a task was completed, the subject notified the secondary investigator and was given the next task to perform. During this entire process, the subjects were also encouraged to "think aloud" any comments or suggestions they had while performing each task.

The third and final stage of the experiment was the interview. During the interview, the subject was verbally asked a series of questions, with the secondary investigator taking notes of every response to each question. Upon completion of all three stages, the subject was thanked for participating in the experiment, and was free to leave. Additionally, any other notes or thoughts the secondary investigator had after each subject testing session were added to the "Post notes from the observer" sections of the templates.

Subject Identification

In order to make it easier for you to identify and recall what subjects did what and what subjects said what, instead of referring to each participant as Subject 1, Subject 2 and so on, each subject mentioned in the following sections of this report will be referred to by an alias name. The aliases used for each subject are listed below in Table 1.

Additionally, the subject's gender and major gathered from the survey are also listed in order to provide you with a better association between the subject and research described.

Table 1

Subject Number	Alias	Age	Gender	Major/Field of Study
Subject 1	Derrick	22	Male	Computer Engineering
Subject 2	Tony	22	Male	Computer Science
Subject 3	Aaron	20	Male	Electrical Engineering
Subject 4	Andy	22	Male	Medicine
Subject 5	Tom	23	Male	Telecommunication
Subject 6	Kevin	21	Male	Political Science / Pre-law
Subject 7	Terry	21	Male	Advertising
Subject 8	Joey	24	Male	Electrical Engineering
Subject 9	Andrea	21	Female	Telecommunication
Subject 10	Stacy	20	Female	Computer Science

A listing of the Subject number, alias used, subject's age, the subject's gender, subject's major

Exploratory Stage

The first stage was strictly exploratory and required the subject to freely explore both the 2D commercial website (Green & White.com) and the 3D experimental website, with the secondary investigator taking notes of the subject's interaction with both websites. Subjects were asked to freely explore the two sites, viewing whatever content they choose and "thinking aloud" about the sites as they explore. Subjects had approximately 15 minutes of exploratory time – seven minutes on each site. An analysis

of the subject's interactions and tendencies after using both interfaces are described below.

> **2D Interface: Interaction Analysis and Comments**

When exploring the 2D interface (Green & White.com), every subject had their own method of navigating and interacting with the content displayed. A couple subjects, mainly Derrick and Aaron, were already pretty familiar with the website and asked to move on to the 3D website after exploring for a short time. The other subjects took a little more time to explore and gave a good amount of feedback as to what they liked and disliked about the site. In addition to feedback, some notable observations and tendencies relating to how the subjects interacted with the website were also recorded as they explored the website. These observations and comments are described in further detail in the following sections.

✓ Organization of the navigation bar / drop-down menus:

Typically, most websites either place their navigation bar horizontally across the top of the page or vertically along the left-hand side of the page. For Green & White.com, this navigation runs horizontally, and there were a couple of comments made by subjects about the organization of the navigation bar.

Aaron mentioned that he liked the organization of the main navigation bar and Kevin and Joey mentioned that they liked the drop-down menus and sub-menus, and how they appeared animated. Terry on the other hand mentioned that he disliked the drop-down menus and would have rather had the buttons in the navigation bar take him directly to the cover pages for each section. Tom mentioned that he did not like the

organization of the navigation bar. He wondered why it couldn't continue with a listing all the sports instead of just listing football, basketball and hockey and then having drop-downs with all the other sports. If the navigation bar would have been place vertically along the side (like ESPN.com) there would have been room for all the buttons. Tom did however mention that he liked the drop-down menu effects.

✓ <u>Opening of pages in another window</u>:

For links that send the user to a different domain, many websites often have the page open up in another window. Aaron and Andrea clicked on "The Noise" link, which sent them to a page outside of Green & White.com and they did not initially realize this and tried to use the back button to go back. Often times this method tends to slow down navigation because most users like to use the back button on the browser to return to the previous page instead of exiting out a window.

✓ <u>Using Right Click to go back</u>:

There are a couple of different methods users can go back to the previous article or page of a website. The most common method is using the browser back button. However, there were a couple subjects that used different methods. Tony used a short-cut key on the keyboard to go back and Andy used the right click button on the mouse to go back. These are methods that were never thought of as an option in the production, and methods I personally have never used. However, some users may rely heavily on these methods for navigation. Even though these details may seem minor, they shouldn't be ignored.

✓ Using the banner graphic to go Home:

Most websites often make the main banner graphic at the top of the page a link, sending the user back to the main cover page or "home" page. If Andy wanted to return to the main cover page, he often used the main graphic at the top of page in order to return. This is something that could have easily been implemented into the design of the 3D web interface but was overlooked. Some users rely on this feature quite often.

✓ Congestion of information displayed:

News media and information sites typically have a large volume of content that have to be displayed, and even though Green & White.com has less content than many other larger news media websites, it still can appear pretty cluttered. Aaron commented that the 2D interface was really cluttered and that "There's a whole lot coming at you". Specifically, he mentioned that the headlines were very congested. Stacy also had similar comments about the congestion.

Another aspect that might add to the congestion of headlines and content is that there are additional headlines and links within the website that do not have any relation to Michigan State athletics. Terry mentioned this, saying he did not like how Green & White.com pushed non-related MSU headlines such as the AP headlines from the Lansing State Journal. Joey, Andrea and Stacy on the other hand, while browsing various sections, mentioned that they liked how there were AP headlines on the left that displayed headlines related to other news around the world.

✓ Using the Calendar:

Green & White.com has a calendar graphic where the user can click on the individual number within the month displayed to see if there are any events happening on that day. If an event is not registered for that day, it takes the user to a page that allows the user to search for an event. Tom also tried to access the calendar but initially thought it was something that you would register events with instead of retrieving information on what events were coming up in the coming months.

✓ State-wide search engine:

On the cover page of green and white.com, there is a search box that the web users can use to search for anything state-wide (Figure 42). This search box also appears on some additional pages, but it does not appear on every page within the Green & White.com domain. Some users rely heavily on search engines like this to find what they are looking for. Kevin noticed the lack of a search box on some of the pages and quickly commented that it would be nice to have them on every page. Some search engines can be annoying, however, because the results that come up are often too broad or they will list entries that come from archives that have not been active in a while. This is probably something that would have been fairly difficult to implement in Director.

Figure 42

7-DAY SEARCH:

- **S** **M** **T** **W** **Th** **F** **Sa**
- **Keyword:**

[**go**]

Archives: (1999 -)

Search box from the home page of Green & White.com

✓ Virtual Breslin and Jennison multimedia

On the right-hand side of each page within Green & White.com, there typically is a box or area that displays links to various multimedia. Within this box, there are two links that, when clicked on, open up interactive simulations of the Breslin Center and Jennison Field house at Michigan State University. By using a few simple buttons, the user can rotate the view in order to see the inside of these facilities in 3D. Both Joey and Stacy were the only subjects that took a look at these to features, and both thought these features were "really cool".

➤ **3D Interface: Interaction Analysis and Comments**

When exploring the 3D experimental interface, every subject had their own method of navigating and interacting with the content displayed. Some subjects focused more on viewing the content where as other subjects focused more on testing the functionality of the website and providing feedback. Observations and tendencies relating to how the subjects interacted with the website, along with some of the feedback produced by the subjects, are described in further detail below.

✓ <u>One handed or two-handed approach:</u>

Most subjects used either a one-handed approach to navigate through the environment and to click on articles, or they used a two-handed approach. The initial thought was that users would use the two-hand approach because this is similar to the controls necessary to play most computer games. However, 6 out of 10 subjects ended up using the one-handed approach. These subjects included Derrick, Andy, Tom, Terry, Andrea, and Stacy. When observing, navigating and clicking using the one-handed approach felt much slower than the two-handed approach because subjects using this method had to keep switching between the mouse and the keyboard.

✓ <u>Testing collision detection:</u>

There were a few subjects that tested the limits of the collision detection as much as possible. These subject included Tony, Tom, and Aaron. Tony and Tom spent a great deal of time exploring the environment by running into walls and trying to find weak points in the collision detection, and both were successful at finding weak points. During both of their sessions, the interface froze up and had to be restarted (Figure 43). Not coincidently, these two subjects are both computer science majors, so they may or may not know a thing about collision detection, or they most likely have had experience testing other interfaces. Aaron is an electrical engineering major and had similar aspirations to try to figure out a way to crash the application, but was unsuccessful.

Figure 43
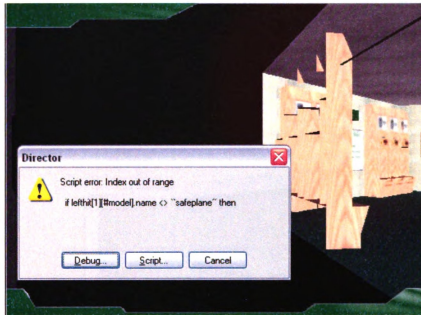
An example of what happens when collision detection fails

✓ Clickable photos and plasma TV

Practically all of the users tried at some point to click on the photos against the "photos" wall of each locker room to see if there was interaction. The capability to click on these photos was something that was thought about during production. The original idea was to make each photo clickable, and with each click, it would swap out the photo with another. However, the photo slideshow concept was used instead. In retrospect, after observing how many of the subjects tried to click on those photos, it probably would have been best to use the previous idea.

Another object within the scene that also had no interaction, but subjects often clicked expecting interaction, was the plasma TV within the Main Room (Figure 44). This object was put into the scene because I wanted to experiment with Real Video, and

the face of the plasma TV was going to be what the Real Video was going to stream off of. However, because of performance issues, it was decided that Real Video was not going to be used. It reinforced the theory that if there is a curious looking object within the scene, users are going to want to click on it.

Figure 44
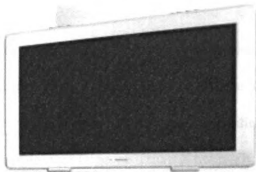
The Plasma TV against the wall within the Main Room

✓ Making photos downloadable:

Somewhat related the section above, Tony and Andy suggested that each of the photos should be downloadable. The method to save photos from an HTML page is fairly simplistic. The user just has to move the cursor over the image, right click, and choose the "save file as" option. In Director however, making this happen would be a little more complex, especially if all the photos were clickable too.

✓ Help system:

Both Tony and Andy suggested that a help system, or some type of help menu, be made accessible after the user begins exploring the environment. The controls text member is the first thing displayed in the 2D viewing area at the start of the movie, but is

quickly replaced as soon as the user clicks on a panel or object. If the user wanted to access that again, they would have to start the application all over again. A help system is definitely something that was overlooked and probably would have been implemented had it been thought of more in production.

✓ Map Display:

Somewhat similar to a help system, Joey suggested that it would be nice to be able to toggle a map in order to help the user get a better idea of where they are at. Although this would have been an interesting feature, how often would it have been used? The environment is not that large, so a map is not really needed. Perhaps if the environment was larger, the capability to toggle a map showing the top view of the environment would have been a nice feature.

✓ Short-cuts to each room:

Because of the time it takes to navigate to each room, a couple subjects suggested that some type of short-cut buttons be implemented. Aaron and Andy mentioned that they wouldn't mind having short-cut buttons at the bottom of the interface that would take them to each section of the locker rooms. However, this would somewhat defeat the purpose of the experiment if all the subject had to do was click on buttons to go to a particular section. A more reasonable approach would be to have short-cut buttons that would take the user to the middle of each room, and from there, they could navigate to the desired section. That way, they would be able to get to the rooms faster, but they would still be required to navigate through the environment some.

✓ Back and forward buttons:

Most of the subjects, with the exception of Joey, did not utilize the back and forward buttons during the time they had to explore. Joey was the only one that really experimented with these buttons and commented that he liked the way the camera moved from one location to another when these buttons were pressed. This movement is almost similar to the way the camera and dummy object moves when the arrow buttons are pressed, but much faster and without having to manually navigate through the environment.

✓ Clickable calendar number:

Aaron commented that it would have been nice to be able to click the individual numbers of the calendar graphic to bring up entries for that day. Although this would have been feasible to do, it would have been rather painstaking. Each of those numbers would have had to have a corresponding clickable panel and text members displaying events for that day. Just how many events are going to be listed on one day?

✓ Ability to strafe:

Five out of the ten subjects while exploring mentioned that would like to be able to strafe, or move the camera from side to side instead of just being able to rotate. These subjects included Aaron, Andy, Tom, Terry, and Joey. This type of motion is commonly using for most video games, and was actually used in the initial stages of the development for this production. The right and left arrows were used to strafe and the

mouse was used to rotate the camera left and right. However, because of some minor problems, the left and right arrows were re-assigned to instead rotate the camera. Other keys on the keyboard other than the arrows could have been used to strafe, but they would have been less practical. If I were to do this production over again, or if was to tweak or add one thing, it would be to implement some way for the user to strafe.

✓ Looking up and down:

Joey and Andrea mentioned that it would be nice to have ability to look up and down. When the subject got too close to an object or wall, they often had to move back in order to get ever thing within view. Having the ability to look up and down could have helped with this, but again, more keys would have had to been assigned to accommodate these controls. Just how many keys are the subjects willing to use during the time they are exploring the site? That's a good question. I have a feeling that after initially playing around with interface and all of the controls at start of the movie, most of these controls would go un-used by most users.

✓ Camera clipping:

There were a few comments about camera clipping, most notably by Tony and Aaron. This occurred mostly around the doorways of each locker room because the camera's field of view is bigger than the dummy object. If the dummy came really close to the edge of the doorway but did not hit it, sometimes it made it appear as though they were going through the edge of the doorway because the camera field of view is just a little larger than the boundaries of collision detection for the dummy.

✓ Scroll wheel capability:

One simple feature that was completely overlooked during development was ability to scroll through the article using the scroll wheel on the mouse. Tony, Andy, and Stacy all mentioned that it would be nice to have this capability. I do not know whether it is capable to implement this using Director, but when thinking about it, it's amazing how important the scroll wheel of the mouse has become in during web use. I personally always use the scroll wheel when scanning through material on the web and rarely ever use the arrows on the scroll bars. Some mice today even have scroll wheels that have the tilt feature, which scrolls the window horizontally. This would have been a nice feature to have implemented and was completely overlooked in production.

✓ Article sound and music:

Two subjects, Tom and Terry, made comments about sounds used for the production. Tom did not like having the music constantly going in the background and also suggested that there be a way to turn off the "article toggle" sound, saying that "it can get annoying". This probably could have been done by inserting a button somewhere within the interface that toggles the article sound on and off. Terry also made a reference that the music in the background is a neat feature, but he did not particularly like that it constantly played. Maybe it would have been best to have the music turned off at the start of the movie, and if the user wanted to hear it, they could simply click on the radio representation to start it.

✓ Article display:

There were two subjects, Andy and Kevin, who made some comments about the way the articles were displayed. Kevin mentioned that he liked the way the article immediately came up without any delay. Most web pages, after a link has been clicked on, have a little delay before the page completely loads. This delay is extended even longer for those pages that have to load through a slower connection. Because the entire Shockwave movie is loaded at once, this delay does not occur when viewing articles within the 3D interface. Andy mentioned that he wouldn't mind seeing the articles come up in a pop-up window, or some window that can be expanded more.

✓ Texture Clarity:

The clarity of the textures was a concern for a couple of the subjects. Tom mentioned that it was hard to see the textures from greater distances, and from certain angles, they became blurry. Terry appeared to have some problems seeing some of the textures, often having to squint in order to read headlines and other panels. However, these textures were not meant to be read from extreme distances or from across the room anyways, which is what these subjects sometimes attempted to do. Most of the other subjects responded that they liked the way the headlines looked and that they had no problems reading the panels and other clickable content.

✓ Multi-media suggestion:

Tony suggested that it would be pretty neat to have implemented some type of multimedia within the production, such as streaming video and so on. Initially, there was

some experimentation with this, which involved streaming Real Video off of the faces of objects within the scene. But it would have sapped the performance of the movie and thus was not used. There is however the capability to use QuickTime in Director too. Tony stated that I would be cool to be able to play QuickTime movies within the 2D viewing area of the interface, triggered by clicking on some object with the scene. This wouldn't be a bad concept.

Currently, there are an extensive variety of sports information websites, but very few that have innovated and pioneered new ways to display content. ESPN.com has made the biggest move by developing ESPN Motion: a multimedia application embedded into most pages, which provides high-quality streaming video to the user. The user can stop, play, and select different headlines within ESPN Motion to view different clips of video.[16] Developing more efficient ways to stream audio and video over the web has become one of the main focal points for many web developers.

One major reason for progress made in the development of streaming audio and video is the connection speeds users have been able to achieve. Residents living in urban areas, or close to urban areas, often have multiple ways to connect to the internet via cable modem or DSL. Users connected via DSL or cable modem achieve much higher speeds than when connected via a 56k modem, which opens the door for web applications that require more bandwidth such as streaming video, and in this case, 3D content for the web.

✓ Select and copy text from the 2D viewing area:

Another small feature overlooked but often very important when viewing content is the ability to select and copy text. Tony was the only subject to mention this, but nonetheless, this should be a standard feature. Also related to this was the observation that a few of the subjects, while exploring the 2D website, liked to highlight text on and off while they were reading articles, almost as if they were trying to keep their hands busy. It's quite possible that simple interactions like this may help to make some web users more comfortable when browsing because it keeps them busy. This is something that was never thought of during production.

Task Performance Stage

➢ Parallel Tasks

After the exploratory stage, it was on to the task performance stage. This method of research involved testing the subject by having them run through a list of parallel pre-determined tasks for both websites while observing how well they managed each task without any guidance. Parallel tasks are matching tasks that were performed for both the 2D interface (Green & White.com) and the 3D experimental interface.

These tasks were verbally relayed from the observer to the subject one at a time and once each task was completed, the subject notified the secondary investigator and was given the next task to perform. The data taken from this stage then was evaluated and analyzed to see if there were any patterns. Ultimately, this research helped to determine how functional and efficient each interface was to use, as well as providing a means to compare how well the subject managed a task from one interface to the same task in the other interface. In all, there were 18 parallel tasks performed by each subject,

and each subject had approximately 15 minutes to complete the list of tasks. An analysis of the parallel tasks performed is below.

✓ Task 1: Locate and click on the 2nd Men's Football headline: "John L. makes a molehill out of a mountain".

Performance Analysis:

For this task, the objective for the 2D interface was to see what drop-down menu the subjects would use. There are the 3 main drop-down's featuring the 3 most trafficked sports such as basketball, football, and hockey, and then there are 2 drop-down's featuring a listing to all the sports for both women and men. All but Tom and Stacy, or 80 % of the subjects, used one of the 3 main cover buttons, in this case football, to access the cover page.

The objective for the 3D site was simple: to see how well the subjects managed to find the football section and the headline representing the article. All subjects immediately started from the main room and knew which locker room they had to go in, and all but Andy, Joey, Stacy, or 70% of the subjects, found the headline with little hesitation. Those subjects that did hesitate some, or had some delay in reaching the section, the time it actually took to reach the section was very minimal.

✓ Task 2: Locate and click on the 3rd Women's Softball headline "Green, Peterson are all-region".

Performance Analysis:

For this task, the main object was similar for the 2D interface as the previous task, but aimed to see how well each subject found the women's softball section under the drop-down. Because this was not a more trafficked sport, it did not have its own button along the navigation bar. All but Tony, or 90% of the subjects, was able to instantly locate the section under the navigation bar without any delay. Tony cycled through a few different drop-down menus, but eventually found the section in little time.

The main objective for the 3D interface was to see how well the subjects found and navigated to the headline. First they had to recollect what room the women's sports were in, and then navigate to it. All subjects did so instantaneously. In regard to finding the actual headline, all but Derrick and Aaron, or 80% of the subjects, found the headline with little delay. Both of those subjects had to navigate around and look at the other sections before they found the right one.

✓ Task 3: Locate and click on the 2nd Main Cover headline "MSU Sports Digest – Published 7-22-2004".

Performance Analysis:

The main objective for the 2D interface was to see whether the subjects made an association with the word "Cover" and the home page, and also to see the method they used to get there. All subjects but Joey, or 90% of the subjects, used the "cover" button within the main navigation bar to locate the article on the front page. Joey ended up using the browser back button to return to the cover page. Additionally, all but Derrick and Tom, or 80% of the subjects, had little trouble finding the link. Tom and Derrick ended up searching around the page for the link a little before finding it.

The main objective for the 3D interface was to see if the subjects would make the association between the "cover" and the main information board where all of the main headlines were placed. 100% of the subjects made the association and navigated to the headline with ease. Terry had some delay reaching the information board, but only because he tried to use the back button to return, which did not work because he had not previously clicked on anything in that section.

✓ Task 4: Locate and click on the Men's Football "Roster".

Performance Analysis:

The objective for the 2D interface was to see what method the subjects used to get the roster. There are two ways: the first is by going the "football" drop down and selecting the roster, or by going to the cover page for football and clicking on the link on the left hand side. 60% of the subjects ended up using the drop-down menus rather the in-line page links. Not coincidentally, the other subjects, who included Joey, Andrea, Derrick, Stacy took longer to find the roster information. It seems as though information can be accessed much quicker by using the drop-down menus.

The objective of the 3D interface was to see if the subjects would associate the rosters with the clickable roster panels on all of the whiteboards within each section. When clicked, the lockers of each section will also bring up the roster information, which was also noted if performed. 90% of the subjects had little trouble making the association and bringing up the roster information, with the exception of Derrick who clicked on the hockey roster instead and took some time to locate the men's football

roster. Tony, Tom, Kevin, and Andrea, or 40 % of the subjects, ended up clicking on the lockers instead of the panel on the whiteboard.

✓ Task 5: Bring up the previous article "Green, Peterson are all-region".

Performance Analysis:

The sole objective for the 2D interface was to see whether the subjects used the back button on the browser, right click, or short-cut key to go back to the previous article instead of simply recalling where the article came from and navigating to the section to click on the headline. Only Derrick, Tony, and Stacy, or 30% of the subjects, used the methods above to go back to the previous article. All of the other subjects tried to recall what section the article was in. Not coincidentally, these subjects took longer to find the previous article than those subjects that used the browser back button or some other method to go back.

The sole objective of the 3D interface was to see if the subject would use the interface back button to go back to the previous article and camera position. Derrick, Andy, Tom, Kevin, Terry, and Joey, or 50% of the subjects, used the back button to go back to the previous article. This was encouraging to see. All of the other subjects navigated back to the section of the article, which took more time.

✓ Task 6: Return to the Men's Football "Roster".

Performance Analysis:

Like the previous task, the objective of the 2D interface was to see what method the subjects used to return to the men's football roster. All but 30% of the subjects

manually navigated to the men's football drop-down menu to select the roster. Derrick used the browser back button, Andy used the right click on the mouse, and Tony used the short-cut key and also mentioned that he would have used the buttons found along the side of some mice that, when clicked, take the user to the previous page. It is interesting that more subjects think about using the back button more so than the forward button.

The objective of the 3D interface was to see whether subjects would use the forward button to return to the men's football roster. All but Andrea, Stacy, and Aaron, or 70% of the subjects, used the forward button to return to the previous selection. And much like the results from using the back button, users were able to return much faster using the forward button than if they navigated manually.

✓ Task 7: Locate and click on the Women's Softball "Roster".
Performance Analysis:

The Objective for the 2D interface was to see if those subjects that used the drop-downs to select the roster in the previous task would be able to locate the roster link for women's softball. Because this sport does not have its own button on the navigation bar like football, basketball and hockey, the link to the roster was only accessible by going to the cover page and clicking on the roster link on the left-hand side. However, all of the subjects managed to find the link with ease.

For the 3D interface, because the subjects had performed a similar task to bring up the men's football roster, every subject accomplished this task with ease. However, it was noted that some of the subjects started to use the back and forward buttons more often. Joey, Terry, Kevin, Tom, Andy, Aaron, or 60% of the subjects, all used the back

button in some way to navigate to a location closer to the article. So instead of using these buttons to go back and forth between articles, the subjects started using these for navigational purposes so they didn't have to manually navigate to the section.

✓ Task 8: Locate and click on the link to go to the "Michigan State University" official website. Exit out when completed.

Performance Analysis:

The objective for the 2D interface was to see how well the subjects managed to find the area where there are links to all of the official websites of the schools within the Big Ten conference. This area is located on the cover page, below all of the headlines and other content, which can sometimes be overlooked. 60% of the subjects had some sort of difficulty find this area. Most of these subjects either cycled through the drop-downs or went to other various pages to try to locate the link. This was most likely because the subjects had to scroll down in order to bring this area within site on the cover page, so the placement made a big difference.

The objective for the 3D interface was to see whether the subjects made an association between the flags in the main room and the links to the official schools within the Big Ten conference. 40% of the subjects had some difficulty making this association initially, but found after a short time. Both Derrick and Tony had to navigate around main room for some time before realizing the flags. Joey and Andy initially thought that they would be able to access the link from the main information board and had to look around before finding it.

✓ Task 9: Locate and click on the Men's Hockey "Schedule/Results".

Performance Analysis:

The objective for 2D interface was to see whether the subjects could locate the men's hockey schedule and results by either using the drop-down entry or using the link on the left-hand side of the hockey cover page. Because this task was much like the one that required the subject to find the men's football roster, most of the subjects found this with ease. 60% of the subjects used the hockey drop-down menu and the other 40% used the link within the hockey cover page.

The objective for the 3D interface was to see how well the subjects could locate the schedule results panel on the whiteboard within the hockey section. 100% of the subjects were able to locate this panel with ease.

✓ Task 10: Locate and click on the Women's Basketball "Schedule/Results".

Performance Analysis:

Because of the previous tasks, all subjects performed the above task for both the 2D interface and 3D interface with ease, and the task probably could have been eliminated. At this point, it seemed like some of these tasks had become repetitive because the subjects have become more familiar with the interfaces of both websites.

✓ Task 11: Locate and click on the headline from Columnist Todd Shultz: "Coaches secret – other interests".

Performance Analysis:

The objective for the 2D interface was to see whether subjects could locate Todd Shultz's columnist section. This was typically located on most of the web pages within the Green & White.com domain along the left-hand side, half-way down the page. 30% of the subjects had some initial difficulty locating this section. Tony, Tom, and Joey scrolled through various drop-downs looking for it. However, most of the subject found this section pretty quickly, most likely because it is more graphical with a picture of Todd, and it is also on most pages within the Green & White.com domain.

For the 3D interface, none of the subjects had any type of difficult finding the column. Because the subjects started out in front of the information board, which is where the column was located, it was probably much easier to recall where it was.

✓ Task 12: Locate and click on the link to go to the sponsor: "Gannett". Exit out when completed.

Performance Analysis:

The objective for the 2D interface was to see whether the subjects could locate where links to the sponsors were located. These were graphical representations located at the bottom of every page within the Green & White.com domain. 90% of the subjects found the link with relative ease. Most websites typically have links at the very bottom of the page and one of the links usually is for sponsor information. Based on the subjects' performance, it would be safe to assume that most of the subjects knew immediately where to go to find information about the sponsors.

The objective for the 3D interface was to see if the subjects could locate the same link. Most of the subjects were already in close proximity to the board for the sponsors

because of the previous task which took them to the main room. 90% of the subjects quickly identified and found the sponsors board. Only Stacy had some difficulty finding it, often looking for it on the main information board. Placement of these sponsors on the main board actually would not have been a bad idea either.

✓ Task 13: Locate and click on the Recruiting headline "Neitzel has Skiles-like skills, demeanor".

Performance Analysis:

The objective for the 2D interface was to see whether the subjects had difficulty finding the recruiting section, which can be accessed by clicking on the "recruiting" button within the main navigation bar. Only one subject, Terry, had any sort of difficulty locating the link. Because he knew the article related to men's basketball, he kept trying to locate the article in the men's basketball section instead of the recruiting section.

The objective for the 3D interface was to see whether the subjects could identify and locate where the recruiting whiteboards were in each locker room. This was a little bit different than the 2D interface because it had been split into two different categories, men's recruiting and women's recruiting. The recruiting button on the 2D interface took the subjects to a page with a listing of all recruiting headlines, women's and men's combined. 50% of the subjects had trouble finding the whiteboard displaying the article. Stacy, Bianca, Joey, Terry, and Kevin all tried navigating to different sections trying to find the headline. A few of the subjects knew that the article related to men's basketball, so they kept trying to find the headline in that section. The others tried to find the headline by looking on the main information board. Maybe this whiteboard should have

been made more visible, or maybe each sports section should have had a panel or area that displayed information about recruiting for that sport.

✓ Task 14: Locate and click on the Recruiting headline "McCallie's secret: Improved recruiting".

Performance Analysis:

After performing the previous task, this task was performed by all subjects with relative ease for both interfaces and seemed rather repetitive. For the 2D interface, the subjects were already on the page they needed to be because of the previous task. Some subjects, however, did take a little time when scanning through the links because, as Andy commented, they appeared really congested. For the 3D interface, all the subjects had to do was navigate to the women's locker room and locate the recruiting whiteboard.

✓ Task 15: Bringing up information on how to contact Green & White.com.

Performance Analysis:

The objective for the 2D interface was to see which method the subjects used to bring up information on how to contact Green & White.com. There were two ways to do this. One was to use the "contact" button in the main navigation bar and the other was to use the link at the bottom of the page to open the contact information page. 80% of the subjects used the contact button in the navigation bar instead of the link at the bottom of the page, most likely because it was more obvious and visible.

The objective for the 3D interface was to see whether the subjects associated the flat panel computer as a way to contact the site. 70% of the subjects made the association

and located the flat panel monitor with ease. Andy, Kevin, and Terry on the other hand initially went to the main board to look for the contact information link. It seems one of the main disadvantages of having the information board is that some of the subjects expected most of the general content (sponsors, links to Big Ten schools, so on) to be displayed on this board. Maybe it would have been best to break this content up and place the separate categories against the walls on separate whiteboards, much like how the content is displayed in the locker rooms.

✓ Task 16 – 2D Interface: Locate and click on the "3/25/2004 Season Review" link to open "Photo Gallery" viewer. Exit out when completed.

✓ Task 16 – 3D Interface: Start the Men's Photo Slide show. Stop photo slide show when completed.

Performance Analysis:

Although these tasks were not exactly parallel, the objective was to focus on how easy it was for the subjects to access the photos. For the 2D interface, there are "Galleries Archive" links state-wide that send the user to a page with various links for different sports and, when a link is clicked, a photo gallery viewer will open to which the user can cycle through photos. However, it was a little bit confusing to some subjects because they thought the "Galleries Archive" links within particular sections like football would bring them to a page displaying links exclusively for that sport, instead of every other sport too. Roughly 7 out of the 10 subjects second-guessed themselves. Most of them actually went to the galleries archive page, but did not locate the link among the sea of links, and ended up browsing around some more before they finally realized the

location of the link. This could have been attributed to the fact that a particular sport was not specified.

For the 3D interface, the objective was to see whether the subjects knew how to turn on and off the photo slideshow. A 100% of the subjects were able to start and stop the slideshow with ease.

✓ Task 17 – 2D Interface: Locate and click on the "2002 Softball Practice" link to open "Photo Gallery" viewer. Exit out when completed.

✓ Task 17 – 3D Interface: Start the Women's Photo Slide show. Stop photo slide show when completed.

Performance Analysis:

Again, this task was a little repetitive. Even though most of the subjects were already on the same page with the location of the link, 40% of the users ended up going to the softball section to look for the link because the task specified that they find the "2002 Softball practice" link. Once they were within the section, they all clicked on the galleries archive link, which sent them to the same page they were just on. So this got a little confusing to most of the subjects. For the 3D interface, none of the users had any problem activating and deactivating the slideshow.

✓ Task 18: Locate the calendar entry: Sat, 9/4/2004, "Rutgers", Football.

Performance Analysis:

This is probably the task that caused the most problems for subjects within the 2D interface. The objective was to see if the subjects could find the calendar entry above.

The problem was that the calendar graphic only displayed the current month and most subjects tried clicking on this graphic multiple times thinking they could change the month to September. But this was not an option. If they had clicked one of the individual numbers, it would have brought up a search page, to which they could then enter in the dates and get a list of results for the date entered. However, 80% of the subjects did not realize this and spent a great amount of time looking for the entry elsewhere. So this was a rather confusing for most of the users.

The objective in the 3D interface was to see if they could locate the entry from the calendar graphic located on the main information board. The graphic of the calendar was pretty visible, and the subjects had visited the information board a few times before, so none of the subjects had any problems completing the task.

➢ Non-Parallel Tasks

The following are non-parallel tasks performed by the subject exclusively for the 3D experimental interface. The reason these tasks were exclusively for the 3D interface is because they involved interaction with features that were not represented within the 2D interface. An analysis of the non-parallel tasks performed is below.

✓ Task 19: Start and stop the "MSU Fight Song" music playing in the background
Performance Analysis:

Most of the subjects were able to toggle the sound on and off in the exploratory stage and did not have any trouble doing the same for this task. Only Andrea had trouble

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identifying what object turned the music in the background on and off, which was the representation of the radio.

✓ Task 20: Open up the caption (or article) displaying what other MSU Men's sports are covered in the section.

Performance Analysis:

The objective of this task was to see if the subjects knew where to locate the list that displayed what other MSU men's sports were covered, which was located in the "Other MSU Sports" section within the men's locker room. This list could be triggered by clicking on the "What Sports" panel of the whiteboard or the lockers. Initially, a couple of the subjects were confused by the question and did not know what to do, so the task had to be repeated. But after a short time of exploring, every subject managed to complete the task.

✓ Task 21: Open up the caption (or article) displaying what other MSU Women's sports are covered in the section.

Performance Analysis:

Once the previous task was performed, there was no more confusion, and all of the subjects completed the task with relative ease after navigating to the "Other MSU Sports" section within the women's locker room

✓ Task 22: Use an alternate way to bring up the Men's Hockey roster (besides the task you did previously that required you to click on the "Roster" link).

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Performance Analysis:

The objective of this task was to see if the subject could trigger another way to bring up the men's hockey roster, besides the method they used to bring up the men's football roster from a previous task. The subject either could click on the lockers of the hockey section or the "Roster" panel on the whiteboard. All subjects quickly identified the alternate method and completed the task with ease.

➢ **Post-notes and Analysis from the Task Performance Stage**

It was interesting to see how some of the subjects navigated through the 3D interface. Once the subjects became familiar with the 3D interface and where objects were located within the scene, recognizing where to go for each task was almost immediate as the testing went on. It was also interesting to see that some of the subjects started to use the back and forward buttons to move around the environment, instead of using the arrow keys to manually navigate. This definitely reinforces the idea that there should be some sort of short-cut buttons that can take the user to each of the rooms.

Within the 2D interface, a couple of the tasks caused confusion, mainly the tasks that involved the calendar and photo galleries. The entire method to search for events in the calendar was confusing for most subjects. It also appeared that some of the material and headlines within the 2D site were a little hard to find because of the congestion of the information. The headline could be right in front of them, but would get overlooked because of all the other surrounding information.

Interview Stage

The third and final stage of the research process was the interview. During the interview, the subject was verbally asked a series of questions, with the secondary investigator taking notes of every response to each question. Each question and the response are detailed in the following sections.

Table 2 summarizes responses to demographic questions.

Table 2

Alias	Age	Gender	Major/Field of Study	Computer Knowledge	Sports Interest
Derrick	Subject age ranged from 20 to 24, with an average of 21.6	8 male, 2 female	3 Computer Engineering or Engineering	9 Above Average	6 Above Average
Tony				1 Average	2 Very Little
Aaron			2 Telecommunication		2 Average
Andy			2 Electrical Engineering		
Tom			Medicine		
Kevin			Political Science		
Terry			Advertising		
Joey					
Andrea					
Stacy					

Summary of responses to demographic questions

✓ **Have you ever visited another 3D based website prior to this experiment?**

Question Analysis:

3 had not done so, 7 had done so. If subjects said "Yes", responses are listed below.

Aaron stated that he did so for a previous experiment. He interacted with a 3D State museum and an Adobe Atmosphere site. He also stated that he "didn't really like it". The controls were not too good and it felt buggy. Kevin also stated that he went to another experiment and visited a 3D State website and Adobe Atmosphere website. They were good, something new. It was interesting.

Aaron stated that he had visited an online 3D church: you could be a character and chat with other users using the application at the same time. He states "it was all right". It reminded him of a video game for the most part.

Derrick stated that he could not remember the names. They related to Student Orgs and a couple company websites. They had some form of 3D, but you could not walk through it. It was a good experience, but most took too long to load.

Joey stated that he has visited some virtual environments using flash, but nothing where he could navigate through to bring up articles. Its fun for a little while, but it gets boring after a while. "Depends on how often you go".

Andrea states, "I know I have" but cannot remember. She couldn't remember any specific ones. There were two research projects for the college. "I think one was a classroom and the other was a campus". She disliked the classroom one because "it felt very sterile". There was nothing she disliked about the campus one.

Stacy stated that she has visited a 3D restaurant site and some motel sites that used 3D and loved it....thought it was cool. As an international exchange student, she stated she would have liked something similar for something like the dorms for orientation.

✓ **Have you ever visited an online sports information site? If so, which site(s)? How much time do you spend browsing during a 7-day week?**

Question Analysis:

All 10 subjects said yes. If subjects said "Yes", responses are listed below.

All subjects stated that they have visited ESPN.com at some point. Derrick said he visits Bitter Rivals and MLive.com. Derrick and Tony have visited Fox Sports. Aaron and Kevin have visited Green & White.com and Spartan Tailgate.com. Andy has visited Sportsline.com and SoccerNet.com. Tom, Kevin and Andrea have visited MSU Spartans.com. Kevin has visited the Detroit Free Press Online. Terry has occasionally visited Sports Illustrated.com and sometimes the state newspaper sites. Joey has visited USSoccer.com and ESPN's Soccernet.com. Andrea has visited Pacers.com, various minor baseball sites, CBS Sports, various local newspapers and the Indy Star. Stacy has visited F1.com.

Derrick spends about 2-3 hours per day browsing sports sites, about 21 hours per week. Tony spends approximately 1 minute per week, Aaron spends an average of 7 hours per week, and Andy spends approximately 7 hours per week. Tom generally spends about 5 minutes a week browsing sports information websites. He said it depends on whether a MSU team is in action. If in action...he spends more time...if not....he doesn't spend as much time. Kevin spends approximately 7 hours a week, Terry spends about 3.5 – 7 hours per week, Joey and spends 10-30 min a week, and Andrea spends about 2 1/2 hours per week. Stacy spends 20-30 minutes per week browsing sports information sites. She said it depends on whether a race is that week.

✓ **During testing, which website did you prefer: the traditional 2D commercial site or the experimental site using 3D technology?**

Question Analysis:

4 subjects preferred the 3D interface, 6 preferred the 2D interface.

Derrick stated that he preferred the 3D site because it was something new and made things easier to find. Stacy stated that she liked the 3D website because "the 2D site is everywhere. It is more interactive, new. It's a pretty logical". Terry stated that the 3D site was more fun. He wished there would have been more short-cuts. It was fun to look at. Looked smaller, but it was probably limited as to how much stuff could be put on it.

Andy stated that he would prefer the 3D if there was a quicker way to get from one topic to the next. He enjoyed the layout, but "there was too much physical time to get there". He stated that he preferred the 2D website in the end because it was faster to go where he wanted to go. Tony stated that the 2D had a lot more info. "Once you're familiar with it, you can find everything pretty fast". He also stated that he did not have learn how to use 2D website, but had to learn how to use the 3D website. Kevin stated that he liked the 3D website. It was easier to see content, headlines, and sections. Overall, he liked the 3D. The 2D was a little faster, but only because you had to learn how to use the 3D website.

Aaron stated that he liked the 2D site. The 2D site "is what I'm used to". It is easier to get from place to place. In 3D you had to walk from room to room. He also stated it would be better if there were short-cuts. Tom stated that he preferred the 2D because the navigation was easier than the 3D site, plus the keyboard mouse combo is more problematic. He also noted some things about the collision detection.

Joey stated that in this case, he probably would prefer the 2D site because it was easier to navigate, but purely for practical reasons. The 3D was entertaining, but for regular use, he stated that he would prefer the 2D site. Andrea stated that she preferred the 2D website because of familiarity. However, she stated that during the tasks, she did not feel as familiar with it.

✓ **Which website was easier to use? Did you have any trouble navigating through the 2D website or the 3D website environment?**

Question Analysis:

4 subjects said the 3D was easier to use. 4 thought they were equally easy to use. And 2 said the 2D was easier.

Derrick stated that the 3D site was easier to find things than the 2D site, like the sponsors. But the 3D site took some time to get from section to section, especially the way the tasks were organized: Men's to Women's, back to Men's. Andy stated that the 3D was easier to navigate through. The 2D was harder because of the huge list of articles. He also stated that the 3D website had an intuitive way of organization, but the physical time it took to navigate was bad. Kevin stated that there was no time involved with the 3D site. In 2D, a couple times he had a hard time finding something. In all, he thought the 3D site was easier to use. Joey stated that he had trouble with the 2D website because there was so much content thrown at you. He liked the 3D website because it was separated by men's and women's, but it took a while to get from each section to each section. 3D also "gave you a visual reference, to help you locate what you were looking for". Andrea stated that the 2D website was harder because everything was spread out all over the place. She states, "The 3D site, once I knew where everything was, it seemed very organized, but it took a while to get there". Overall, the 3D site was easier.

Terry stated that overall he preferred the 2D site because of familiarity. He knew how to work it. Tony stated that 2D website was hard to navigate because "I was unfamiliar"

with it. He also stated that the 2D was really cluttered. The 3D needed a scroll feature for article. He stated it felt like he could get to items more immediately in 2D. Aaron stated that the 2D website was easier, but he didn't really have any problem with either of them. "I'm a computer pro". You had to walk from room to room in the 3D website. There could have been a lot more info in the 3D site. Tom stated that one site was not easier to use than the other. Because of the keyboard mouse combo, it made the 3D site more problematic. He also noted that the calendar on the 2D site was a bit confusing and that the months should have been swappable.

Stacy stated that the 2D website had a lot of information and was hard to navigate through, especially the small font ones. Todd Shultz was easy to find because of the picture. There is just so much info within the 2D website, plus she did not like the way it directed to the main Lansing State Journal. She preferred the 3D website, but it would have been more difficult if there was more content.

✓ **If you rated 1 for question 5, did the content displayed in the 3D interface seem confusing or difficult to understand? If you rated 2 or 3 for question 5, did the content seem easier or more difficult to understand?**

Question Analysis:

2 subjects said it was harder, 6 said it was the same, and 2 said it was easier.

Derrick stated that there were NO complications, easy to use. Andrea stated that the 3D site was easier because it was right there on the right. The 2D website "had all this crap on the right and left side of the article".

Tony stated that he did not really read in depth, but he could understand the content well. Aaron states, "Say it's about the same as normal sites".

Andy stated that the article would be easier to read if it was expandable and wider. He also stated that he would have preferred a pop-up feature, possibly having multiple windows open at once.

Tom stated that the 2D site was cluttered when it came to looking for headlines and that he had to use the search a couple times. The 3D site headlines were blurred from a distance and could have used a thinner font.

Kevin stated that it was different, the way the article pops up on the right hand side. He states, "If it's there, I'm gonna read it". But neither site was easier or more difficult.

Terry stated that he had trouble with 2D calendar task and the gallery section. He said it was fun navigating through the 3D site using the arrow keys, but going back and forth was annoying. He wished there would have been short-cuts.

Joey stated that one site was no easier to use than the other. "When you clicked on it the article came up". Referring to the 3D site, he states "It did give you a 2D aspect though". "If it popped up on say a wall or something, I think that would be frustrating". It was nice to have a combo.

Stacy stated that she thought the headlines were blurry, but the articles were fine. She also had to circulate around the room to see the headlines correctly.

✓ **Were there any bugs that came up, or technical problems that occurred during your testing of the site using 3D technology?**

Question Analysis:

6 subjects said no bugs, 4 encountered bugs.

Derrick stated that the music and sounds were not playing, and he went right through the wall into black. He had to restart the 3D site. Tony stated that it crashed a couple times and he had to restart. There was clipping with the camera, appearing to go through some walls. He also stated that after you clicked on a website link, you had to click within the w3d to gain control back. Tom stated that he could walk through the walls and through the tables and chairs sometimes. Kevin stated that it crashed the one time on the back button operation after pressing it really fast a few times. It had to be restarted.

✓ **How did you feel about your 3D experience? Did it frustrate you? Was it enjoyable? Describe any feelings you had.**

Question Analysis:

6 subjects said it was enjoyable. Two were unsure. Two said it was frustrating.

Stacy stated that it was very exciting and was not frustrating at all. It was a lot like a game. "If I had to do it every day, it would not feel professional". Derrick stated that he thought it was enjoyable, interesting, and something new. He thought "wow" and didn't know what to expect, but "it surprised me" ;Tony stated that "it was enjoyable". He also stated that he wished there was more content. In general, it needed more content. The interaction did not matter to him as much. Aaron states, "I'd say it was enjoyable", it was different. Graphics were pretty decent. Kevin stated that "it definitely did not frustrate me". It was a little different. It was nice to move the guy around. It was a cross between the new and old, with being able to navigate, but also being able to use the back buttons. Joey stated that it was enjoyable and entertaining. He also stated that "On a day-to-day basis, I would prefer the 2D site".

Andy was somewhat unsure and stated that it "felt like more of an exploration instead of a digital newspaper". Tom stated that "It was new experience, but not really". A lot of Flash multi-media used flash media graphics, so it's not really anything different then what we have out on the web already.

Terry stated that while getting around, he got a little frustrated. Navigating from room to room was difficult and annoying, but navigation through the actual content was not. Andrea states, "I was frustrated when performing the tasks". "But once I started doing it, it became better."

✓ **Did the 3D sports website environment feel realistic? If so, what elements felt realistic? If not, what elements did not feel realistic?**

Question Analysis:

8 subjects said that it felt realistic, 2 said it did not.

Tony stated that it did not feel very realistic. He could not look up and down. The models did not look real. Anti-aliasing felt wrong. He saw black from a distance. But the movements, forward, left, right, felt real. He would have liked to look up and down. Tom stated that it did not feel that realistic. He saw seems in the walls and lockers. Some of the colors were off. The chairs looked pretty good though.

Derrick stated that it "Felt realistic". He was a bit skeptic as to whether the lockers from the 3D site really looked like the actual lockers from the real locker room but everything in the Locker rooms looked pretty realistic. He states that the only thing that did not seem realistic was the Main Room Information Board because "that probably would not be in a locker room", and the music probably wouldn't have been playing either. There would not have been band music playing in the background. But it was a cool feature.

Aaron stated that it was realistic. The jersey's felt realistic. The TV that didn't work felt un-realistic, but other than that, it felt pretty realistic. Andy stated that it felt realistic in the event of the motion back and forth. The search method was realistic, intuitive. There wasn't really any un-realistic stuff. Kevin stated that it felt "Realistic-enough of me" "It made sense, a locker room for sports". Nothing was random. It was all pretty obvious.

Terry stated that the locker rooms felt really realistic. He also said the dry boards with the headlines felt pretty realistic. Joey stated that he thought it felt realistic. The music in the background, the slideshow on the wall, individual lockers and uniforms, chairs, and the whiteboard font all felt pretty realistic to him. However, walking through objects and the blurriness of the images sometimes did not feel realistic. Andrea stated that it felt pretty realistic, the locker room. "Most people do not get to be in a locker room. But it's not something that distracting". She also stated that walking through the chair felt unrealistic. Stacy stated that she thought it was realistic, but "not in a sense that I was walking through it in real life". But in a graphical sense, it was realistic.

✓ **At any point did you feel nauseas during testing?**

Question Analysis:

All 10 subjects said no.

✓ **Having experienced the website using 3D technology, would you like to see more sites developed that use similar 3D technology?**

Question Analysis:

7 subjects said yes, 2 were unsure, and one said no.

Kevin stated "Sure...why not. Try it out. The more options the better". Terry stated that yes, he would like to see more developed, but it depends on how they present it. Like the sports concept and how it was set up with the locker rooms. "It's hit or miss". So for instance, the metaphor is good, but if it wasn't and it was just more random objects...than

no. "So yes, I would like to see more". "It's much more interactive". Andrea stated that she thinks it's a beneficial tool for learning. "It's easier to pick up things". 2D sites tend to change their organization and navigation more often. Stacy stated, "Sure, the dorm room one or 3D version of that" or "Even for Formula 1".

Derrick states, "I would like to see it.", "A lot more sites". Aaron states "Yea sure. You can get more information on a 2D site, but 3D felt like an overall immersive experience". Tom stated that he liked the 3D objects in the form of graphics and stuff because they stood out realistically. Graphically…yes, functionally right now…no. He states that "pretty much whenever memory catches up processor speed", maybe he would like to see more sites developed.

Joey stated that he thinks so, but only with certain websites. Not with news websites or sites that are constantly updated. Like websites built for movies and sites that you can have a metaphor or theme to it. He also stated that it makes you feel more into it. Andy was a little more non-committal about whether he would like to see more 3D sites and stated that he wouldn't mind it as long as they had buttons (short-cuts) to go to areas faster.

Tony said no, stating that "I surf the internet for content. If I want interaction, I'll play games".

➤ Post-notes and Analysis from the Interview Stage

The most interesting data collected from the interview stage was that 4 out of 10 subjects preferred the 3D interface more so than the 2D interface. I thought it would have been around 1 to 2 subjects, or 20%, that would have preferred the 3D interface over the 2D interface, so the results were somewhat surprising.

I also noticed that those subjects that said they preferred the 3D interface over the 2D interface, and mentioned that they would like to see more development of similar interfaces, also had and medium to high interest in sports, so there is a definite correlation there. Those subjects that had a higher interest were less critical and more forgiving.

It was nice to see that 6 out of the 10 subjects thought their experience with the 3D interface was enjoyable and 2 out of 10 were unsure or non-committal. Also related was the ease of use of each interface. 4 out of 10 said the 3D interface was easier to use, another 4 said the 2D interface was easier, and the other 2 said it was about the same. This tells me that they had a relatively easy time with navigation and they did not get frustrated that often, which is critical if you want users to keep coming back.

As far as the suggestions are concerned, the short-cut buttons to each room, the ability to strafe, and the ability to scroll and copy text were a few of the most common suggestions. All of these suggestions could have and should have been considered in the design, but were overlooked, neglected, or just plain forgotten about.

Conclusions

To emphasize again, the objective of my thesis was this: to create a functional, efficient website that utilized 3D technology as means of navigating through content, and then test its functionality and practicality by subjecting it to user testing. Based on the results of the research, I would have to say my thoughts are somewhat mixed as to whether this type of technology would be a good alternative to what already exists on the web today. Are 3D interfaces such as the one developed for this production practical enough to be considered for use in the development of websites?

First of all, in order for this type of technology to be considered, many of the features overlooked or neglected during the development of this production would have to be included in most designs. There were many little things, or not so little things, that could have and should have been implemented. Some of these features included the ability to select and copy text, being able to save pictures and images, and the ability to use the scroll wheel to scroll through content. These features may seem minor, but all have become standard interactions of web use and are interactions that most users expect to be capable of doing.

Other features overlooked or neglected that would have made it much easier on the user in terms of navigation included the ability to strafe, the ability to look up and down, being able to access a help system, and possibly providing short-cut buttons to speed up the time it takes to navigate through the environment. These short-cuts, along

the ability to strafe, were two of the most common topics brought up during subject testing amongst the subjects.

With all this being said, there were some great things that came out of the research that provided a great amount of optimism. I particularly liked the response by a couple subjects during interviews who mentioned that they thought the interface was more immersive and they felt 'more into it'. There are not very many websites on the web today that have the capability to bring out these types of feelings amongst web users. This is something that might give 3D interfaces an edge over 2D interfaces in the future – the ability to immerse the user. If a proper theme or metaphor is carefully thought of, it certainly helps to make the user feel more immersed into the interface.

Although 60% of the subjects said they still preferred the 2D site, many of them mentioned that their familiarity with using 2D interfaces was the main reason why. This is something that comes with time. Some of the subjects initially had a hard time finding certain sections during the task performance stage, but once they learned where everything was situated and became more familiar with the layout, the tasks were completed much faster. Like every new development that comes out on the web, users often have to adapt, and it would be no different if 3D interfaces started to become mainstream.

Another interesting observation derived from the results of the survey is that there seems to be a strong correlation between the subject's interest in sports and some of the responses they provided in the survey. Out of the ten subjects that responded whether they would like to see more 3D interfaces developed for the web, 70% of the subjects said they would like to see more, 20% of the subjects were unsure or non-committal, and

10% said they would not like to see more 3D interfaces developed. Out of that 70%, all seven subjects listed that they had an average to above average interest in sports, where as two out of the three subjects representing the other 30% specified they had a below average interest in sports. What does this mean? It probably means that the general theme and content of the site (athletics) had some affect on what the subjects thought of the production. Those subjects that had a higher level of interest in sports appeared to be more interested and accepting of the 3D interface where as those subjects that had a lower level of interest in sports were more critical and less accepting. These types of interfaces would most likely have to be designed with a pretty narrow and specific target audience in mind in order to be effective.

So the question still remains: Can 3D technology be used as a functional, efficient component in interface design for the web? Based on the results of the research, I would say yes base on some of the research, but only after a few more advances are made, and if the methods to develop such interfaces are simplified. Ultimately though, at its current state, I would have to say that 3D technology is not a practical alternative for interface design in web development. There is a great amount of potential, even if 60% of the subjects said they still preferred the 2D website. 40% is not a bad figure for a technology that has not been used all that much to create interfaces for the web. Like Flash when it came onto the scene, current 3D Shockwave movies are still best suited for entertainment use instead of for practical interfaces, but they will adapt. And when they are able to do so, and when web users become even more familiar with the technology, that's when we'll see a boom in development of interfaces utilizing 3D technology.

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