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360 Panographic: A Collection of Spherical Panoramas

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CHAPTER ONE:
ABSTRACT

Many people turn to traditional still photographs in an attempt to experience a place without actually being there. While traditional photographs can be very useful and persuasive, 360º spherical panoramas can give viewers a much more in depth and immersive experience. This project focuses on creating a series of high quality 360º spherical panoramas of San Luis Obispo and the central coast. Along with these panoramas, this project includes a branding and identity package for the collection of panoramas, as well as a fully functional website that is easy for both viewers and contributors, by developing it in a way that will lead to easy updates in the future without the need to manually edit HTML code to keep the site up to date. This report will discuss and alanyze the reasons for this project's existence as well as the methodology that was used to complete it.

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CHAPTER ONE:
INTRODUCTION

This report will review, in detail, the process (both conceptual and technical) behind the creation of "360 Panographic," an online database of spherical panoramas showcasing the San Luis Obispo area of the Central Coast of California. 360 Panographic was developed in order to give a "virtual tour" of the area surrounding Cal Poly University to individuals that are either not able to visit the area in person, or who would like to share the beauty of the Central Coast with others who might be unable to visit for themselves. Often times, tourists contemplating visiting the San Luis Obispo area, as well as prospective students to Cal Poly do extensive research on the area before visiting. Most of these individuals view still images online to get an idea of what the area looks like and whether or not they would like to visit (or for prospective students, whether they might be interested in living in the area while attending the university). These static images, however, fail to give their viewers a true sense of what the Central Coast has to offer, because, while still images can be beautiful and effective, they lack the ability to give their viewers the experience of actually being there. 360° panoramas, on the other hand, give a much more true-to-life view that is closer to what an individual might experience if they were to physically visit the location the panorama was taken at.

The site itself contains a gallery of numerous 360° panoramas that are interactive and allow the visitor to control their "view" and the "direction" that they are looking in the image. A traditional static image only gives a limited view of any location and necessarily leaves out information that prevents that viewer from truly experiencing the location at which the image was taken. 360° panoramas, on the other hand, include a full view in every direction of the location the image was taken in, allowing

the viewer to see everything they would if they were actually physically there. The images are of very high quality, which enables the viewer to see the details of the location and even to zoom in to get a closer look of the area, much like they might do in person.

The creation of 360 Panographic can be broken down into 3 main sections: the development and creation of the site's brand, the process of creating the spherical panoramas, and the design and development of the actual site where the panoramas are showcased. This report will discuss the research and conceptual ideas of each of these sections as well as the actual process that was used to create their final products.

STATEMENT OF THE PROBLEM

This project attempts to create an professional online collection of spherical panoramas of the central coast that are of extremely high quality that will entice viewers to visit the area by giving them an interactive experience of the area that cannot be rivaled by still photography. This includes the creation of a brand identity and matching web site that is not only easy for visitors to navigate and experience, but that is also easy to be updated so more spherical panoramas can be added in the future. Due to the number of panoramas that are likely to be shot, a system and workflow will also be developed to make the process of shooting, stitching, editing, and uploading a large number of panoramas a technically feasible process that will ensure the site is updated well beyond the first batch of panoramas.

PURPOSE OR OBJECTIVE OF THE STUDY

I chose to create this "360 Panographic" project as a way of combining two cutting edge forms of photography and graphic design, my two main areas of study.

The creation of 360° spherical panoramas is something that I've been interested in exploring for some time. It is a very unique photographic process that is very specialized, and has a relatively small number of professionals who practice it. The process by which these panoramas are created is very complicated and time consuming, but it often results in images of stellar quality that can be much more effective than traditional photography. I wanted to bring my passion for this type of photography to Cal Poly and San Luis Obispo the hopes that it might give prospective students and tourists a better online experience of what the San Luis Obispo area has to offer if they chose to either visit or attend the university.

The goals that I set out to accomplish with this project necessitated the creation of a web site to showcase these panoramas and make then publicly visible to anyone who might be interested in viewing them. This opened a perfect opportunity for me to inject the graphic design skills I have learned at Cal Poly into the project while also allowing me to explore some new areas of web design that I had previously had little experience with.

LIMITATIONS OF THE STUDY

In order to accomplish all that I set out to do in such a short ten week window, I was forced to limit certain areas of the project. My main goals were to develop the branding and identity for the site, the process and workflow for shooting and producing the spherical panoramas, and the actual design of the site itself. Since all of these processes were going on at the same time, I limited the number of panoramas that I would initially shoot, in order to make sure there was enough time to design and code the web site so that it would be functional and ready to be opened to the public in ten weeks from the start of the project. I designed the site in a way that it can be easily updated in the future, so the goal was to get a limited number of panoramas onto the site initially, to make it look like a functioning gallery of

panoramas, but not so many that all my time would be spent shooting dozens of panoramas without having the time to finish the design and coding of the site. The number of panoramas was really the only limitation placed on the project, the rest was open to whatever methods and techniques were needed to make the site look and act like a professional interactive collection of panoramic photography.

GLOSSARY OF TERMS

The following terms will be used throughout the rest of the report and may be new or unfamiliar to anyone who has not had experience shooting spherical panoramas or developing web sites.

Control Points: a point that exists in two overlapping images that are used to line up and stitch the images together into a panorama.

CSS: Cascading Style Sheets. A web programing language that is used to set certain styles or looks to elements throughout a web page. By using an external style sheet, styles like type size, font, color, image borders, sizes, etc, can be set in one location rather than needing to be declared each time an element appears in HTML code. For instance, by declaring in an external style sheet that all hyper links should be a specific color, it is not necessary to set that color in the HTML code for each hyper link. This makes updating and changing the design of the site much easier. It also reduces the amount of time it takes a typical web browser to render each HTML page.

Cube Faces: After a seamless panorama is created, it is processed into 6 separate images that when placed together in a 3D environment create the 6 sides of a 3D cube. When viewing a panorama, the viewer's "location" would be in the center of the "cube" with the 6 cube faces wrapping all around them.

Field of View: the number of degrees that a lens can capture in a single image, or the combined number of degrees that are covered by a panoramic image. For example, a spherical panorama has a 360°x180°field of view, meaning that it covers every possible angle horizontally and vertically.

FPP: Flash Panorama Player — the software and set of code used in this project to display the spherical panoramas on the web site.

HDR: High Dynamic Range. This refers to taking a bracketed sequence of exposures for each image, which are then blended together later before the final panorama is output. By blending exposures, the final image will have detail in highlight, midtone, and shadow areas that might otherwise go dark or be blown out with a single exposure.

HTML: Hyper Text Markup Language — the basic web programming language that all web sites are written in.

Identity: the mark/logo/image that is the graphical representation of a brand.

MySQL: a web-based database that stores information. In regards to this project, the web site uses a MySQL database to keep track of the each panorama, its corresponding images, thumbnails, and text information. The PHP scripts that are embedded into the code of the site pull information from the MySQL database to display information dynamically on the site without having to custom create a separate page for each individual panorama.

Nodal Point: the point at which all rays of light entering the lens of a camera converge. By centering the camera around the nodal point of the lens, parallax errors can be eliminated

Masking: the process of hiding or showing parts of layered images in photoshop.

After a panorama is "stitched," it is sometimes necessary to use layer masks in photoshop to hide or reveal certain parts of the overlapping images to help blend the seams between the images.

Parallax: errors that occur when stitching a series of images together when creating a panorama. These errors usually result in the images not lining up properly on the seams. This is caused because the position of the camera has changed during the exposure of the panorama (usually because the camera is not rotating around the nodal point of the lens), which means the different images have different perspectives to them

PHP: a programing language used in web design that creates dynamic web pages that can automatically populate themselves based on user interaction and content stored in databases

PTGui: the software that has been used in this project to "stitch" each set of images into a 360º spherical panorama

Spherical Panorama: a set of images taken in every possible direction and angle from a single point that are then "stitched" together later to produce a single seamless image that shows a complete 360º view

Stitching: the process of combining multiple images taken at different angles together to create a seamless panoramic image. When a series of images that cover a complete 360ºx180ºfield of view are stitched together, the resulting image is a spherical panorama.

Wordpress: an online blogging platform that is based on HTML, PHP, and MySQL databases that features a content management system that allows for easy updates of content without having to edit any HTML code

XML: a programming language. For this application, xml files were used to set the parameters and preferences for each individual panorama (such as the starting viewpoint, speed of auto-rotation, size,

CHAPTER TWO:
REVIEW OF RESEARCH

During the creation of 360 Panographic, there were many areas that required research, but the three components of the project that were the most complicated and required the most research were the stitching process, transforming the stitched panoramas into some interactive web format, and the creation of a dynamic web site that could be easily updated. The majority of research was centered around analyzing a number of existing methodologies and how they might be combined to create a workflow that would make the process of shooting, stitching, and uploading all of these panoramas possible. Because all of these areas are relatively new and based on recent technology and computer software, the majority of research for this project was done on the internet.

By reading forums and blog posts on panoramic photography web sites, I was able to analyze a number of existing technologies and techniques and discover which of these would be the most viable for the 360 Panographic project. Once the different methods and technologies were chosen, I devised a way of combining them together to create the highest quality images and the most user friendly site I could.

EQUIPMENT RESEARCH

My first step in the research process was to determine how to shoot 360º panoramas in the most effective and efficient way without sacrificing quality. I already had some experience shooting spherical panoramas before I began this project, so I was already familiar with the basic concepts (shoot a series of overlapping images, process them into a single seamless image, convert them to a cubic format that could be could be interactively viewed. However, my experiences shoot-

ing panoramas in the past were usually very awkward, slow, and definitely not very efficient. Previously, I had been shooting panoramas with a Canon 20D and either a 17-85mm or 10-22mm lens. With these lenses I was forced to shoot a minimum of 18 images (on the 10-22mm) or 30 images (with the 17-85mm). Once I started shooting HDR images (3 bracketed exposures per image), suddenly I was shooting a minimum of 54 to 90 images, which is far too many to be to shoot more than a handful of panoramas here and there. The process becomes to long and time consuming, not to mention the fact that during the time it takes to shoot 90 images, the lighting conditions and general appearance of the scene I was shooting would drastically change, which would in turn cause serious issues blending the images together into a seamless panorama.

By consulting a series of panoramic photography web sites I was able to analyze and compare the field of view of a number of different lenses to determine which lens would give me the greatest quality while keeping the number of images I would need to take at an acceptable level. I consulted vrwave.com's extensive database of photographic lenses, which lists the number and angle of images needed to get full 360ºx180º coverage. Once I had narrowed it down to a few lenses, I consulted a some online communities of panoramic photographers, such as panoguide.com to compare the quality of the lenses. By asking other photographers who were using these lenses, and by inspecting the resulting panoramas they had shot with them, I was able to determine that the best possible quality/speed combination was to use a Canon 15mm f/2.8 Fisheye lens on my Canon 5dmkii camera. This combination allowed me to shoot a minimum of 8 images (6 images with the camera horizontal, 1 with the camera angled up, and 1 with the camera angled down) to get a full 360ºx180º field of view when all 8 images were stitched together.

Once I had determined the lens and camera I would be using for the project, I needed a way of rotating this camera/lens combination around the nodal point of

the lens (to eliminate parallax errors and make stitching and blending the images possible). Because of my earlier experience shooting panoramas, I knew there were a number of companies that manufactured specially made panoramic tripod heads that are designed to rotate the camera and lens around the nodal point of the lens. I went back to the panoguide forums to determine which of these panormic tripod heads would best suit the needs of the 360 panographic project. After comparing the features of a number of panorama heads, I decided to use a Nodal Ninja 5 to shoot all the panoramas for the 360 Panographic site.

FINDING THE NODAL POINT

One of the most time consuming parts of research I did was to try and find the best way of locating the nodal point of the 15mm f/2.8 fisheye that I would be using for the project. After reading at least two dozen articles, blog posts, forum discussions, and any and all other information I could find on the internet, I eventually discovered a guide written by Thomas Schwenger that suggested using a laser-level to project light throughout the lens at different angles. The guide on his web site guides you through the process of finding the nodal point. Since, according to Schwenger, the nodal point "is an attribute of the lens, and as such, is independent of the camera," it is possible to calculate the nodal point of the lens by merely shining light through it and measuring where the light overlaps inside the lens. I won't go into detail of the procedure on Schwenger's site, but once you have created the templates he has designed, it's simply a matter of shining the laser into the lens and moving the lens forward or backward until the light projects through the lens. Once that happens, the nodal point has been calculated.

However, after following those steps, I did more research and discovered that on fisheye lenses, there is actually no fixed nodal point, but rather the nodal point moves around depending on the angle at which light enters the lens. It is therefore

necessary to ensure that the angle at which you point the laser into the lens corresponds to the number of degrees between the number of images you will be shooting. Since the nodal point effects parallax and parallax causes the most problems on the seams between the images, it is essential that you find the nodal point that matches up with the point where the images overlap. With Canon 15mm f/2.8 fisheye lens, you must take 6 images around horizontally. If 360°÷ 6 images = 60° per image, then you must make sure that the nodal point is measured so that it is centered around the point where light that enters the lens at a 60° angle converges. To do this, you must place the laser at a 30°angle from the center axis of the lens (30° to one side of the axis + 30° to the other side of the axis = total of 60° field of view). The laser level will then transmit light through the lens and also make a red line above the lens which will be the exact distance back (from the front of the lens) that the nodal point is located at. Once you've done this, you can adjust the panoramic head to match the nodal point settings of the lens. After the nodal point has been found, then you can begin shooting panoramas.

STITCHING PANORAMAS

I also found it necessary to do some extensive research into the methods and procedures for stitching 360°panoramas together. In the past I had let the software auto-stitch my panoramas together for me, but that often resulted in stitching errors along the blending lines of the images and sometimes warped or distorted final blended images. In some cases, if images in the panoramas lack detail, the stitching software is unable to successfully align the images and the process fails. After doing more research on the panoguide forums, I was able to develop a way of creating a template that the stitching software could use as a base point for stitching all subsequent panoramas. The idea behind the template is that you can shoot one very detailed scene, manually align all the images in the panorama by picking

control points (1 pixel areas that appear in the overlap area between two images in a panorama) and then using those control points to align the images. Theoretically, according to some individuals in the panorama community, it is possible to create a perfect template that you can use for each and every panorama that you shoot without having to change any settings. I, however, have found this to be very difficult and most likely impossible. All the panorama heads on the market use a simple bubble level to level out the tripod, and if the tripod is even off-level by the slightest amount, the so called "perfect" template that was created in the past will produce errors because the "perfect" template was shot at a slightly different angle than the current panorama. Instead of attempting to create a "perfect" template and ending up with stitching and blending errors in my panoramas, I designed a method to quickly align and optimize each panorama with minimal amounts of actual user input. This method will be discussed in more detail in chapter three's procedures section.

CHOOSING A WEB FORMAT

Once the final panorama is stitched, optimized, and blended into a final seamless image, it must be converted into a format that allows users to interact with it online. Most of the research concerning this part of the process dealt with discovering which formats were available and which were viable options. By reading through the panoguide forums, browsing other panorama sites, reviewing source code, and analyzing the output options for PTGui (the stitching software I used for the project), I was able to narrow the options down to either using the Apple Quicktime VR container, Flash Panorama Player, or Pano2VR. These three formats were knee deep in a "format" war across the web, each with their own avid following and their own pros and cons. After I had narrowed it down to those three, I ran a series of tests with each and set up a few dummy panoramas to watch how people interacted

with the different players. After researching the three of them further, I came to the conclusion that Flash Panorama Player was the most compatible across multiple computer platforms and browsers, it was smoother and more professional looking, and was much more able to be manipulated to fit into the design of the web site. There are also a great deal of extra preferences and controls that can be set for Flash Panorama Player, since each panorama allows for its own xml file of preferences and settings (such as auto rotation, rotation speed, friction, load time, and initial pan and tilt settings).

WEB SITE CMS RESEARCH

From the moment I decided to use a web site to showcase the 360º panoramas, I knew that it would be necessary to have some sort of CMS (content management system) built into the site to handle updating it. Having to open up HTML files and manually edit HTML and XML code every time I shot a new panorama would be very time consuming and tiring and would likely eventually end with a lack of updates to 360 Panographic. The best solution to this problem would be a way of designing and coding all of the necessary areas of the website at the beginning of the project and then using some sort of content management system to add new content to the web site later without having to actually edit code. I had used WordPress once before for a simple blog, and I knew that while it seemed simple, it had a lot of complex features that could likely do everything I would need the CMS to do for the 360 Panographic site.

After spending many hours reading through the WordPress documentation and forums, I decided that WordPress would, in fact, be a viable option for the CMS for the 360 Panographic site. After reading through many of the options for customization with PHP strings and custom fields, I was able to develop a system to link the images output from the panorama stitching software to the wordpress database,

thereby eliminating the need for me to manually code anything after the initial design of the site was finished. With the method I developed, I can treat each panorama like a blog post, which includes a link to the panorama images. The PHP code in the site will automatically reformat itself to accept the new panoramas and it will dynamically display new content when users click on panoramas without the need for me to make an HTML page for each new panorama I add.

At this point, I had done all the research that was necessary to determine which pieces of equipment, which tools, and which software programs I would use to create 360 Panographic. The next step would be the actual creation of the 360 Panographic identity, web site, and workflow for shooting and outputting the 360º panoramas.
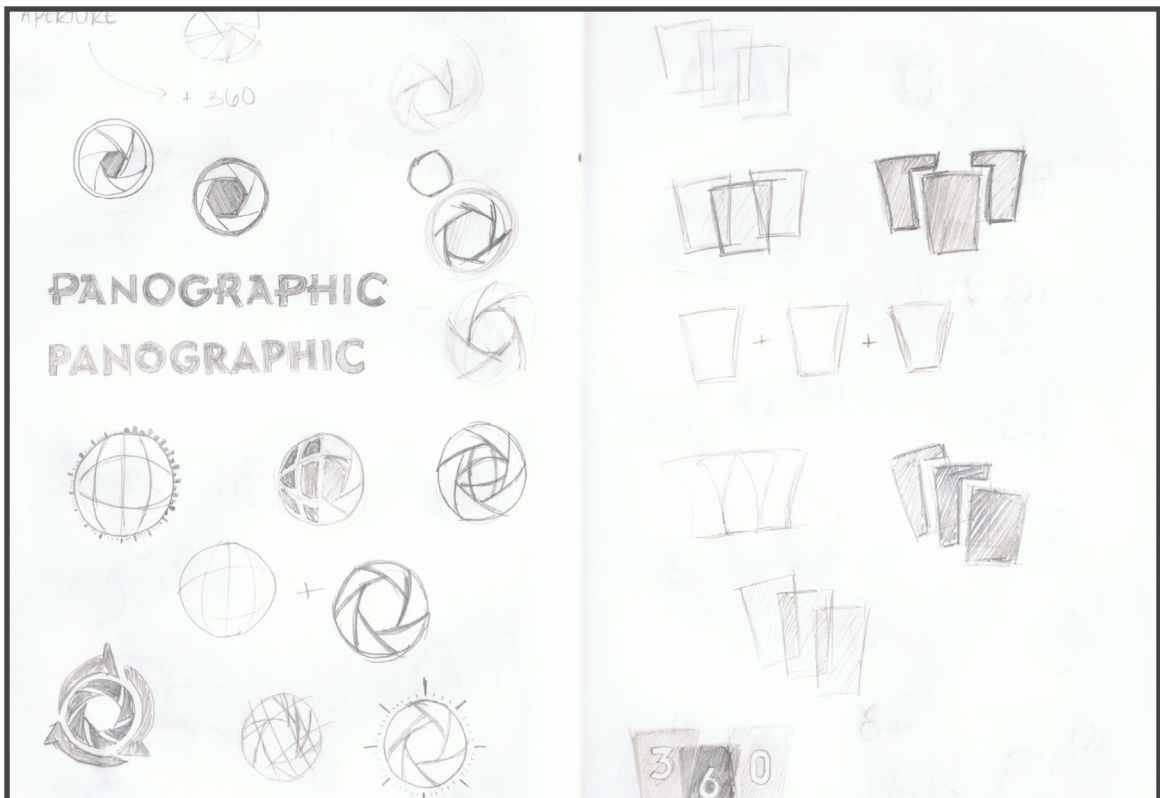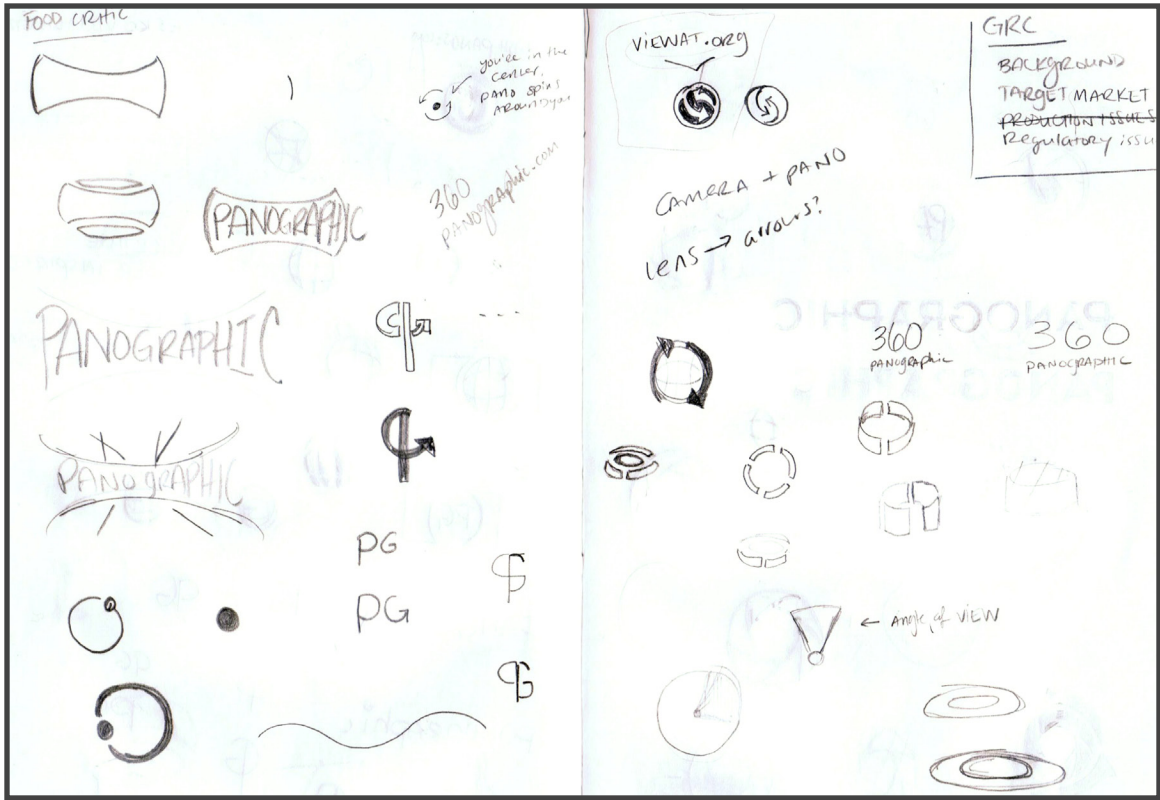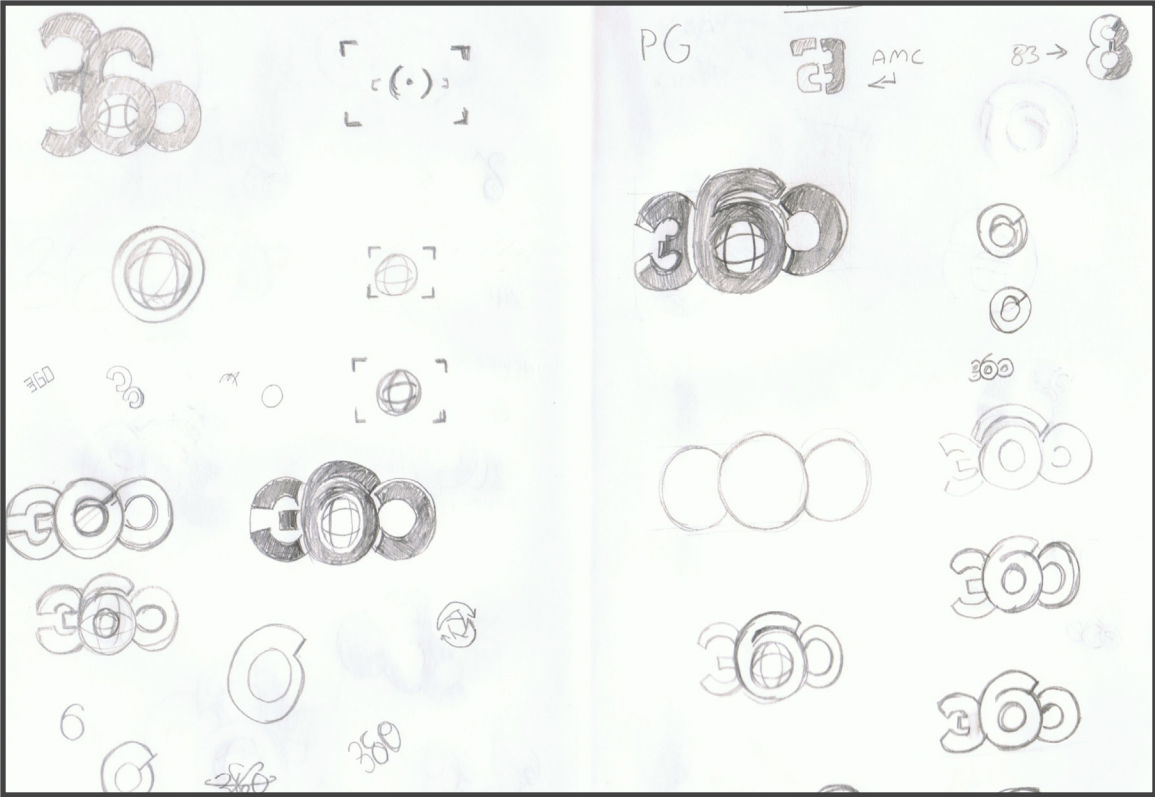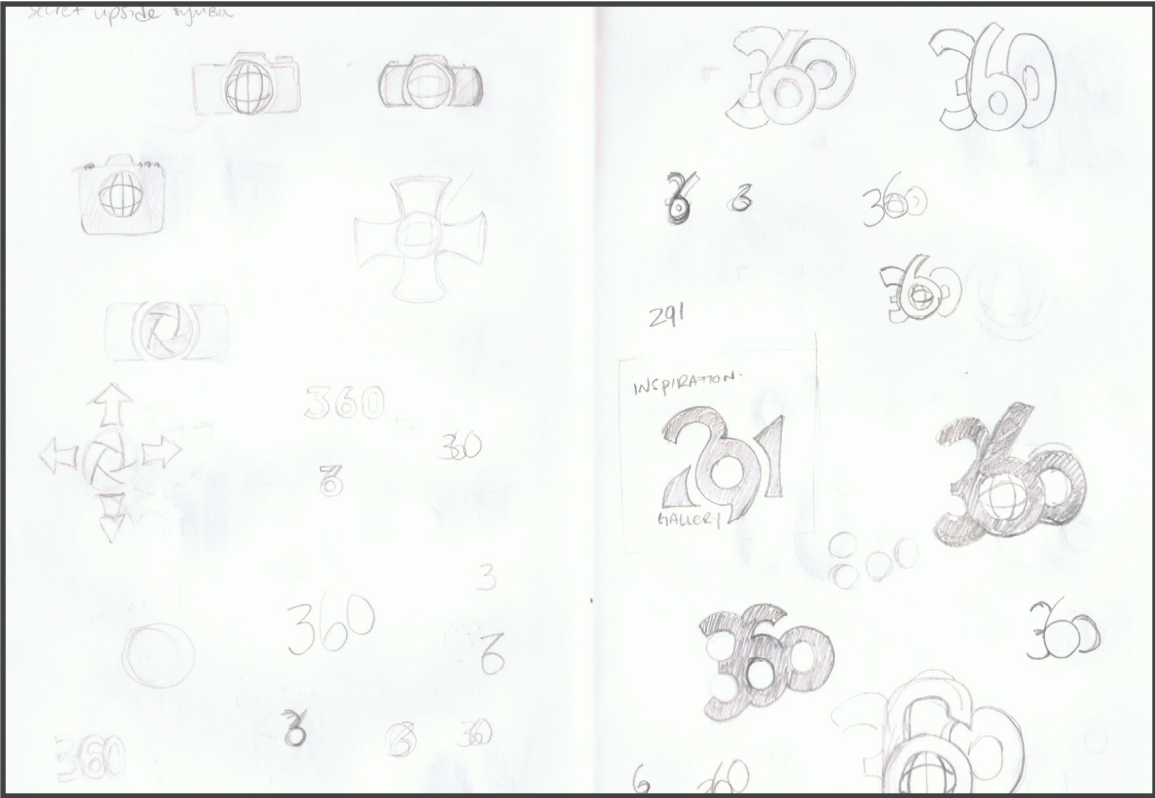
CHAPTER THREE:
PROCEDURES AND RESULTS

Once I completed the research for the different elements of the project, I began to put the ideas on concepts that I developed during that stage into action and began to actually create the project. I split the process into three parts, which I will describe separately below: first, the design of the brand and identity; second, the creation of a workflow to create the panoramic images (and the actual creation of the images), and lastly, the design and coding of the web site.

IDENTITY

The first step of the process was to create the identity for 360 Panographic. The identity would help shape the look and feel of the rest of the project and critical graphical element. All other steps, mainly the web site design, would have to follow in the footsteps of the identity.

To create the identity, I first began to break down the idea of the project and what needed to be conveyed in the logo. It needed to be something that people could see and recognize what the logo represented. It was also important that it have some significance that linked back to the concepts and ideas behind the project as well. After I had settled on the name "360 Panographic," I began to brainstorm different graphic elements that could be linked to photography, panoramas, virtual tours, 360º, everything that I could think of that could be connected to the concepts of the project. After I brainstormed for a while, I began to sketch as many thumbnails as I could of things that could possibly be used to represent 360 Panographic. The following few pages are some of my initial thumbnail sketches for the identity.

I first began experimenting with only symbols and shapes to convey the idea behind 360 Panographic, but I soon realized that including 360º in the identity would not only help to link the identity with the name of the project, but that it would also help people identify what exactly the project was all about.

As you can see, the sketches on the previous page begin to approach the final design for the logo. At this point I moved to the computer and began to experiment with typefaces and subtle changes to the shape and size relations between the 3, the 6, and the 0. The image below shows my initial designs on the computer. By now I had decided on using the 360 as a logotype. I knew that something needed to fill the center of the counter in the 6 and I began experimenting with the idea of placing a wire frame 3d sphere inside of the 6 to represent the way that the images in the panoramas "wrap" around you while viewing them in the flash viewer. This concept continued to evolve, but eventually I decided that the wire frame 3d sphere

was too complex. I began experimenting with typefaces around this time as well and did a series of type studies to help decide which styles would best convey the surrounding, enveloping, experience of viewing a 360º panorama. After reviewing many typefaces, I decided to use "Insignia" for the "panographic" portion of the logotype. The round circular forms of the O, G, and C all echoed the spherical elements of the panoramas, and the strong horizontal serifs on the other letters helped convey a sense of movement that is created when the viewer is able to take control and spin the panoramic image. None of the 360 type, however, really did what I was looking for. I wanted the 360 type of be perfectly spherical to really bring home the shape of the spherical panoramas. I ended up developing those numbers from scratch to control every element of them (which is important because those are the three main forms of the logotype). The next stage of the logo development

PANOGRAPHIC	INSIGNIA ROMAN	360	INSIGNIA ROMAN	360	BAUHAUS LIGHT
PANOGRAPHIC	AVANT GARDE MEDIUM	360	AVANT GARDE MEDIUM	360	BAHAUS MEDIUM
PANOGRAPHIC	AVANT GARDE BOLD	360	AVANT GARDE BOLD	360	BAHAUS DEMI
PANOGRAPHIC	CENTURY GOTHIC BOLD	360	CENTURY GOTHIC BOLD	360	BAHAUS BOLD
PANOGRAPHIC	FUTURA BOLD	360	FUTURA BOLD	360	BAHAUS HEAVY
PANOGRAPHIC	FUTURA EXTRA-BOLD	360	FUTURA EXTRA-BOLD	360	EUROSTILE DEMI
PANOGRAPHIC	FUTURA HEAVY	360	FUTURA HEAVY	360	EUROSTILE MED.
PANOGRAPHIC	FUTURA MEDIUM	360	FUTURA MEDIUM	360	EUROSTILE BOLD
PANOGRAPHIC	METRO BLACK				

consisted of forming the 3, 6, and 0 out of perfect circles and working on connect-ing them into a single unit. While working on this stage, I realized that by placing a circular element into the center of the 6 it would be a "place holder" of sorts, a "you are here" dot as if to suggest that you (the viewer) are surrounded by 360 Panographic. From here, there were small refinements in stroke widths and kerning. Eventually, after much fine tuning, this became the final 360 Panographic identity.

PANORAMAS

I shot a total of 12 spherical panoramas for the initial set of panoramas on 360 Panographic, each of which took a considerable amount of time and effort to pro-duce. The process for each panorama was relatively similar, so I will discuss the process from start to finish for one of the panoramic images.

First, as with any good outdoor photography, I had to wait until the weather and lighting conditions matched what I was looking for in the shot. Many times this meant being on location at sunrise and waiting for the orange glow to hit my mod-els or location just right, or getting to a location in the late afternoon and waiting

until the conditions changed to meet my requirements. Once I was satisfied with the lighting and the weather conditions, I could begin actually shooting the panorama.

Because of the extreme contrast in tonal values around the 360º image, I was forced to bracket a set of three exposures, that way when the camera was facing away from the sun I would be sure to capture all the shadow and highlight information, and then when the camera was facing towards the sun, I would only blow out minimal amounts of highlights surrounding the sun. If I was shooting a model in the panorama I would often use a reflector to bounce some light back their way and fill in some of the shadows on them (this helped to give the panoramas a more professional and controlled look than many of the other panoramas on the internet today). I would then commence shooting and take a total of 24 images per panorama (8 normally exposed, 8 underexposed, and 8 overexposed). All images were shot in manual exposure mode so that when the final panorama was stitched there would be no tonal shifts throughout the image.

Once these images were all processed in Adobe Lightroom, they were exported as TIFF files and imported into PTGui to be stitched into panoramic images. Because I had three sets of exposures, I stitched each exposure set as its own separate panorma, which would result in full spherical panoramas for each single panorama I shot. Since I was unable to successfully create a batch processible template for my panorama head, I would import the first set of exposures, apply my template, and then fine tune the control points between the images. I would then optimize the images, which corrects for any changes in lens distortion, camera position, and the leveling of the camera. After the initial set of exposures was blended into a panorama, I would swap out the images with the images from the other two exposures and create two more panoramas that were identical except for their exposures.

The next step of the process was to blend the three differently exposed panoramas into a single high dynamic range panorama. To complete this step I used a program called HDRMax. All three exposures were loaded into this program which would use tone mapping algorithms to blend the three exposures together —giving detail to shadow, midtone, and highlight areas of the image. This process is very tricky, because HDR, done incorrectly, can look very fake and unnatural, a look that I did not want to come through with my panoramas. A subtle use of HDR, on the other hand, ensures proper exposure across the very wide spectrum of tonal ranges that are produced from a 360º view. In this step, each panorama that I shot required its own fine tuning of HDR settings to ensure that it looked dynamic enough without looking unnatural. Once I was satisfied with the look of the three blended panoramas, I would export a single TIFF file from HDRMax that could be further corrected and manipulated in Adobe Photoshop. The following page shows three bracketed panoramas (normal exposure, over exposure, and under exposure, as they were output from PTGui.

As you can see, none of the images are very good by themselves. Any image that has shadow detail has completely blown out highlights, any image with detail in the highlights has completely black shadow areas. Once these three exposures have been blended by HDRMax however, they take on a much more even tonal range that retains detail in all areas of the image. The panorama below is an image exported from HDRMax without any additional manipulation.

This image is much more interesting, and is technically a much better photograph. However, at this stage, there was still more that could be done to enhance the photo, so often at this point, I would take this blended HDR panorama into Photoshop and make some further adjustments. Any panoramas the involved movement would also end up with halos or ghosting effects around the moving objects, which would need to be removed in Photoshop after HDR blending. In this example, the man with the surfboard did not remain perfectly still between all three exposures, so he ended up with ghosted halo around him in the final HDR blend. To fix this, I would bring in one of the single exposures (usually the normal exposure) to photoshop and use a series of layer masks to remove the ghosting elements.

To further increase the quality of the photograph, depending on the situation from panorama to panorama, I would add a series of coloring adjustments, saturation adjustments, remove lens flare, or add a semi-transparent layer of yellow around the sun area set to a "hard light" blending mode, to give the final panorama a more realistic effect of looking into the direction of the sun. The images below are of the HDR blended panorama before and after the finishing touches were made in Photoshop. As you can see, they are very similar, except for minor changes to the overal color, the removal of lens flare, and the addition of a subtle highlight around the sun.

From this point, the final single Photoshoped panorama was sent back to PTGui, where it was exported as six separate images (one for each side of the virtual 3d cube). This process removes much of the distortion that overpowers the flat panoramic images. The series below shows the 6 flat images after they have been exported from PTGui.


The images are much less distorted than they are in the flat panorama, however, they aren't quite ready to go on the web yet. If you look at the bottom image, known as the nadir, you can see that there is a missing section in the middle. This area is not included in the final panorama because it is where the tripod supporting the camera was while I was shooting the panorama. However, when I finished shooting the panorama, I moved the tripod and took a photograph of the ground without the tripod in the way, which I then used to fill in the missing area on the nadir image. Once the nadir image is fixed, the six "cube face" images can be exported as compressed JPEGs and uploaded to the web site along with a thumbnail image and an image of the panorama's location on a map (which will be dynamically added to the panorama's page on the site later). Once the files are uploaded, the lengthy and somewhat complicated process of creating a superior quality high dynamic range panorama is complete.

WEB SITE DESIGN AND CODING

After the identity was finished, I began working on the initial designs for the web site. The beginning of this stage consisted of sketches and photoshop comps.

Once I had a very tight and finished look for the site, I moved into coding the actual site from the WordPress PHP files and then eventually into some extra advanced elements of the site, such as the javascript based contact form and email subscription forms.

The main purpose of the site is to showcase the panoramic images, so from the very initial stages, the site design was very simple and clean. A lot of panorama sites on the internet today are very cluttered and busy, filled with go ogle ads, ratings, lists of equipment used for each panorama, and generally bad design that stands in the way of simply enjoying a good photograph. To combat that, I kept the site incredibly simple with subtle sharp lines and a complete lack of unnecessary
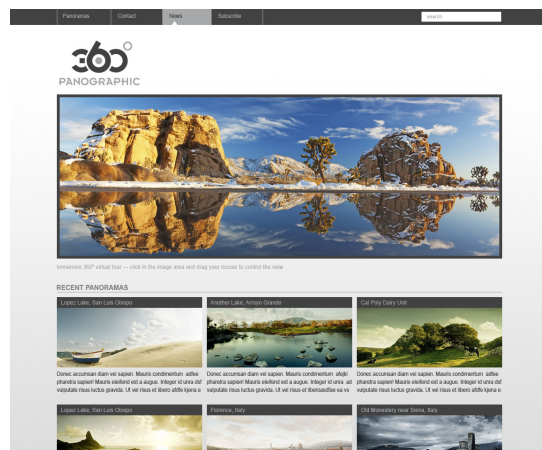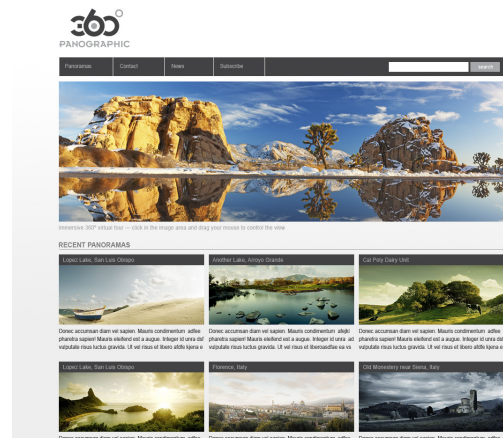
items.

Once the mock-ups of the site reached a satisfactory level, I began to implement the designs into the WordPress code by editing the HTML, CSS, and PHP source files. To create the site, I designed a home page, a single post page that dynamically changes based on which panorama a visitor clicks on (essentially it's a single file that is able to be used for all the panoramas rather than needing to create individual web pages for each file), a contact page, subscription page, and an archive/gallery page that showcases thumbnails of all the panoramas (this page also dynamically changes and will automatically add new thumbnails and move the existing thumbnails over).

By adding to the PHP of the WordPress files to include an area for "custom fields" it is very easy to add new panoramas to the site. All that needs to be done to upload a new panorama is place the 6 "cube face" images, the map image, and the thumbnail into a single folder on the web server, then log into the WordPress CMS and add a new post. From there, I can fill in a title, whatever text I would like to have show up on the panorama's "page," and then the custom field which is the name of the folder the "cube face" images were uploaded to. There's no need touch any HTML or even open up a web editor. It can all be done by logging into the site and just typing in plain English. The following pages contain example images of the differ net pages of the site.
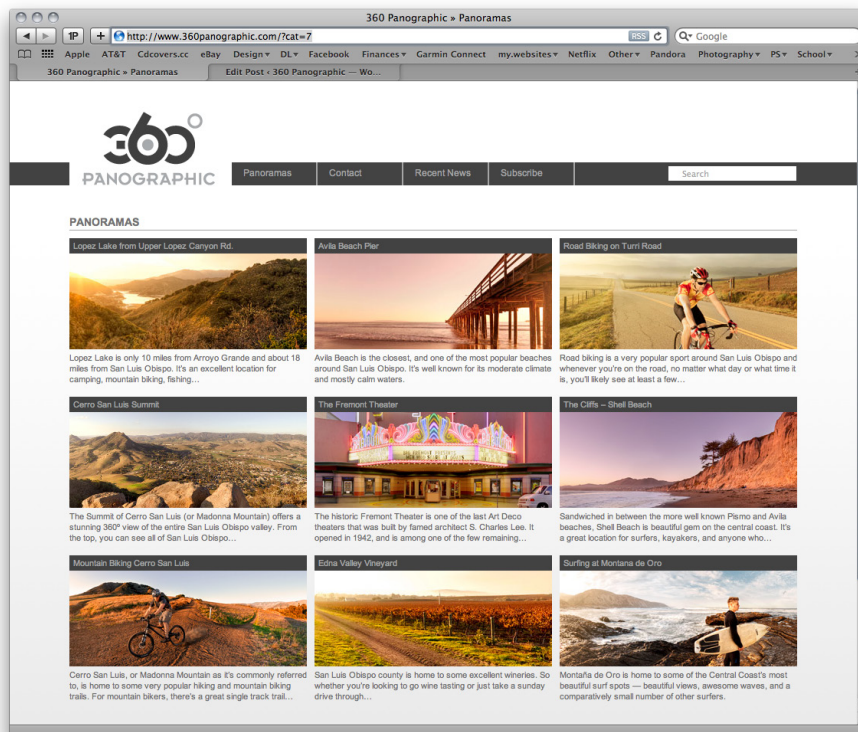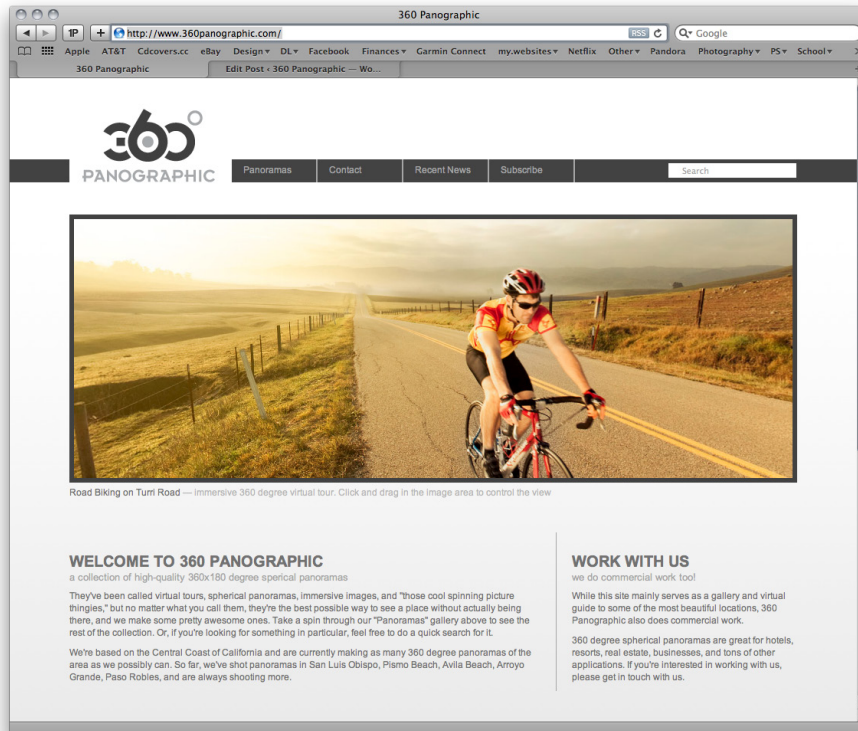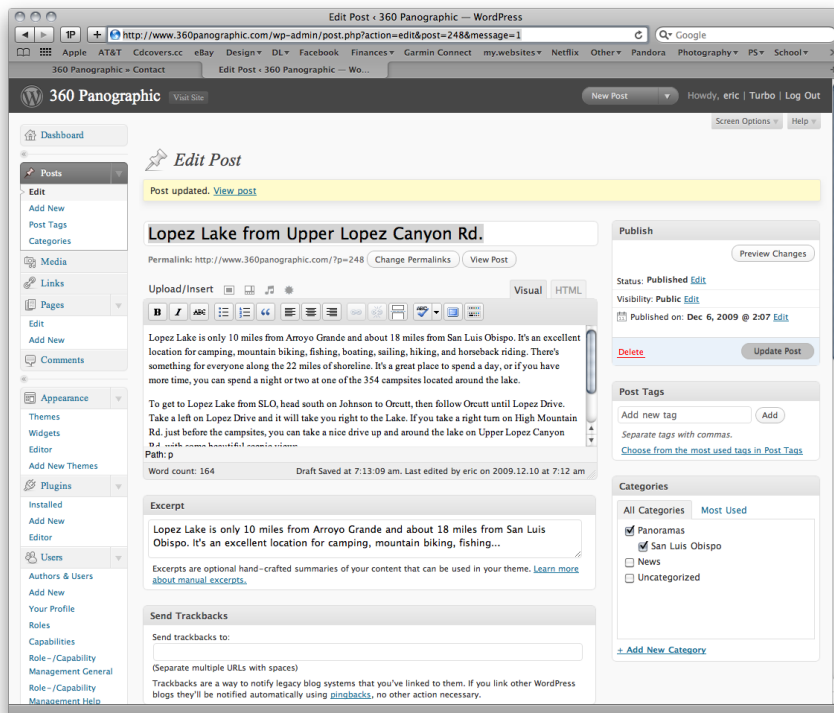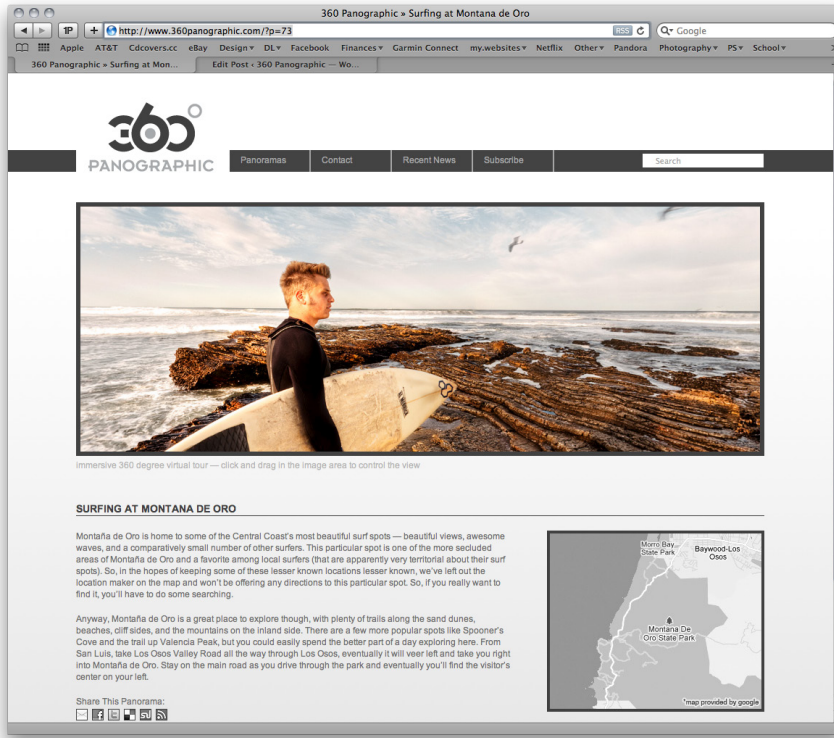
CHAPTER FOUR:
SUMMARY

After ten weeks of work, the 360 Panographic project is still a work in progress. The goals that were set forth in the initial objectives of the project have been met, but the site will continue to grow in the future. During that ten week period, 360 Panographic transformed from an idea of a way to show the best features of the central coast into an live website that is already generating hits and comments across the web.

The project consisted of three main parts, first, the development of a name and identity that will help draw viewers in while at the same time helping to clarify what exactly 360 Panographic is and what exactly 360 Panographic does. The concept that 360 Panographic is based on really needs to be seen and experience in order to be understood, so it's important that the identity system that represents 360 Panographic be able to convey some of those concepts to people who may not have never heard of it before.

Secondly, the project included the creation of system and workflow to be able to shoot, stitch, blend and upload a series of high quality panoramic photographs as well as the actual process of following that workflow for a series of 12 panoramic images that are now featured on a publicly accessible web site.

Lastly, the entire project culminated in the creation of a dynamic web site that combines the simple yet elegant graphic elements with the high quality panoramas. The site is easily updatable without having to ever touch any HTML or PHP code. This will help ensure that 360 Panographic does not die off soon after this finishing date, but that instead it will continue to grow and expand for years to come and that

someday in the future it might contain an even larger collection that showcases the entire San Luis Obispo area as well as other parts of the Central Coast.

RECOMMENDATIONS

While working on this project, I made a few discoveries in some areas of the web site, specifically Flash Panorama Player's ability to link panoramas together. Because of time constraints, I was unable to explore some of these features, but in the future, it might be possible to link panoramas together to provide an even more "immersive tour." For instance, when the panorama from the top of Cerro San Luis loads, other panoramas that are "within view," such as the panoramas from the base of Bishop's Peak could be activated as well, and by clicking on Bishops Peak, the Bishop's Peak panorama could load and replace the Cerro San Luis panorama. This could be especially useful for multiple panoramas that were shot in close proximity to each other. Say, for instance, a panorama of the exterior and interior of the Fremont theater —by clicking on the doors of the theater, the panorama could transition from the exterior to the interior. As the site grows and expands, these options will be explored and may be implemented to increase the functionality of the site.

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