ANIMATION AS AN EFFECTIVE TOOL FOR COMMUNICATION:

A DIGITAL PROTOTYPE FOR MIDWEST ALIVE

MASTER OF FINE ARTS THESIS

Presented in Partial Fulfillment of the Requirements for the
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By

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ABSTRACT

This project displays how a designer uses animation to convey multiple complex layers of time-based information concurrently through the use of functional and visually engaging graphics rather than static text and images. This project consists of developing a combination of visual graphics such as a web interface, linear 2D animation and 3D animation, an interactive timeline, and a virtual environment. In order to develop these displays successfully, the project also consists of establishing design criteria that are applied to this project and can be referenced for projects of a similar scope. The visual displays developed are used to better explain early roadway development in the Midwest using computer animation rather than static mediums. This is done to take advantage of the ability to layer and cross-reference pertinent material in order to better communicate the process of how, over time, trails were formed and how those trails became major roads and highways throughout the Midwest. This project also shows how early roads influenced the path direction and development of later roads. The project focuses on the first major thoroughfare in Ohio, called Zane’s Trace, and how that route influenced the development of the National Road, State Route 40, and finally I-70, all of which opened up the Ohio country and the land west of it to exploration, trade and settlement. This visual representation will be the first in a series of interactive and linear works, used specifically by Midwest Alive, a group responsible for creating graphics for the Encyclopedia for the Midwest. The project can be viewed on the CD-ROM included with this document and online at the existing Encyclopedia of the Midwest website (http://www.allmidwest.org).
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CHAPTER 1

INTRODUCTION

1.1 HISTORY OF THE PROJECT

The Institute for Collaborative Research and Public Humanities is producing The Encyclopedia of the Midwest, here at The Ohio State University with funding from many sources such as the National Endowment for the Humanities (NEH). Along with The Encyclopedia of the Midwest, many encyclopedias for other regions are being developed at other institutions such as The Plains, New England, and Appalachia. The Encyclopedia of the Midwest, a hardback book, will document important events throughout the history of the region’s land, arts, culture, religion, and people (Zacher). The encyclopedia is designed for use in schools, colleges, libraries, museums, and homes as well as businesses, government agencies, tourism departments, and convention bureaus everywhere.

Currently, The Institute for Collaborative Research and Public Humanities has created a website (http://www.allmidwest.org) for The Encyclopedia of the Midwest which is used to describe the encyclopedia and its sections, to show visual images of the Midwest, and as an online forum for the editors and writers of the encyclopedia. Each of the sections on the existing Encyclopedia of the Midwest site is a work in progress and has a brief description of its contents and contains few visuals. The sections of the encyclopedia are as follows:

1. Portraits of the states
2. Images of the Midwest
3. Geography
4. Peoples
5. Language
Dr. Christian Zacher, Director of The Institute for Collaborative Research and Public Humanities wishes to create *Midwest Alive*, which would be an expanded on-line digital encyclopedic compendium of information about the American Midwest. *Midwest Alive* would provide on-line visuals and graphics for *The Encyclopedia of the Midwest*. A main goal of Midwest Alive would be to provide the public with an interactive interface and exciting visuals that stimulate the user’s imagination. Another goal is to influence typical stereotypes that people, in general, have of the Midwest such as that the Midwest is flat, full of corn fields, and overall a
"plain" region. Zacher hopes to use the prototype that is developed in this study to gain further funding and demonstrate what could be done, in digital form, for the *Midwest Alive* project.

### 1.2 PEOPLE INVOLVED IN THE PROJECT

The producers of *The Encyclopedia of the Midwest* and the organizers of *Midwest Alive* are Professor Richard Sisson from the Department of Political Science, The Ohio State University, and Professor Christian Zacher from the Department of English, The Ohio State University. Coordinating the relationship between Sisson and Zacher and myself, a graduate student at The Ohio State University, is Maria Palazzi, the Director of The Advanced Computing Center for the Arts and Design and Associate Professor in the Department of Industrial, Interior, and Visual Communication Design, The Ohio State University. Also advising on the project is Peter Chan, Assistant Professor for the Department of Industrial, Interior, and Visual Communication Design, The Ohio State University.

### 1.3 MY ROLE IN THE PROJECT

As a graduate student, this is my MFA Thesis project, and my objective for this study is to develop design solutions for the presented design problem. Along with developing design solutions, my role is to also execute the design in prototype form. I coordinate the project schedule and present process and progress to Chris Zacher, Maria Palazzi, and Peter Chan.

### 1.4 PROBLEM STATEMENT

Throughout the entire encyclopedia complex historical information exists with overlapping historical events that influence one another. One specific area of focus of this project that is being documented is Section 19: Transportation. This section details the history of trails, routes, and highway systems beginning with Native American trade and communication trails. This information is very detailed and documents events going back into the 1700's. The section consists of overlapping layers such as specific geographic locations, American Indians, important Explorers and Settlers, the process of road making, the movement west, and time. These topics are dependent upon each other and cross-referencing is often necessary. For example, the
geographic location of rivers influenced where the animals traveled, which influenced the paths of Native Americans that were hunting the animals, which, in turn, were the fundamental beginnings of early roads created by Explorers and Settlers. The following chart demonstrates the overlapping layers for a specific event in the section such as the making of the first road in Ohio, *Zane's Trace*:

![Diagram of overlapping layers]

**Figure 1.1: The Number of layers that overlap one another in this one event**

Although one could refer to existing linear material such as written documentation, images, artwork and model exhibits in museums, it is difficult to visualize the evolution of the entire process as a whole. The static quality of these linear materials makes it difficult to comprehend the evolutionary process because of the time element involved (from pre-historic days to present) and the complexity of all of the factors, such as glaciers and changing topography, the development of Native American villages and trails, and economic and social development throughout the Midwest contributing to the development of major roads in the U.S. Graphically, the prototype will describe the following:

4
1. The influences of early roads on major roads that exist today
2. Roadway Development - through the phases of Land Formation, to Animals, to Indians to Explorers, to Settlers
3. Social Development - early settlements and towns to existing cities
4. Topography
5. The Movement West

1.5 PROCESS OUTLINE

This prototype displays the way animation can be designed to convey multiple complex layers of information concurrently through the use of functional and visually appealing graphics rather than static text and images. In order to achieve this successfully, the approach process involves five major phases to the project, as seen in the Process Outline (Figure 1.2). Figure 1.2 demonstrates that this approach is mainly a linear process with fluctuation back and forth between the Design Execution and Evaluation phases.

Figure 1.2: Process Outline and Design Phases
Design Research- Defining area of project and major design problems and/or questions; creating project schedule; researching information, graphics, and interactive design theory; evaluating existing visual displays and websites; formulating theories on successful and unsuccessful design for visual displays.

Design Ideation- Defining early ideas and concepts and brainstorming and storyboarding concepts and layout of project.

Design Execution- Creating prototype.

Design Refinement- Based on critique of early ideas and execution, refining prototype.

Design Evaluation- Test and Evaluation by my Graduate Committee members.
CHAPTER 2

DESIGN RESEARCH

The first phase in my approach is Design Research. This includes identifying the scope of the project, identifying the existing and potential design problems, and establishing design criteria for the project.

2.1 IDENTIFYING PROJECT SCOPE AND DESIGN PROBLEMS

Project Scope

This project involves developing three visual displays that coincide with historical data to be used as a prototype for Midwest Alive. The project involves developing methods of communicating data in non-static, interactive form specifically with the use of animation. The prototype will be viewed on-line or on a CD-Rom.

Design Problems

1. How do I visually represent information changing over time in an interactive web interface?

2. How do I effectively show 2 dimensions, data/spatial maps and time concurrently?

3. How do I develop a web interface that is logical and effective for the user? What components are necessary for me to achieve this?
4. How does my interface interact with Midwest Encyclopedia's site?

5. How do I design for such a diverse user group?

Once these design questions and problems have been asked, establishing the design criteria that structure the design solutions can begin.

2.2 ESTABLISHING DESIGN CRITERIA – EXPERT THEORY AND EXISTING DISPLAYS

2.2.1 INFORMATION DESIGN OVERVIEW - EVALUATING CRITERIA

According to Edward Tufte in *Envisioning Information*, "...enriching the density of data displays are essential tasks of information design" (Tufte 33). Showing information successfully is a growing problem for many reasons. Some of which may be that people are exploring design with more abstraction and dimension than ever before in informational displays. Data is becoming more complex and the way the data is communicated is becoming more sophisticated. Another reason for the difficulty in showing information successfully is the focus on ornament over data. Tufte states, "Too many data presentations, alas, seek to attract and divert attention by means of display apparatus and ornament" (Tufte 33).

In any communication device, a progress of methods should exist in order to enhance density, complexity, dimensionality, and even beauty (Tufte 33). Tufte describes and analyzes many maps and informational displays in his book *Envisioning Information*. His evaluating criteria are based on fundamental theories he and other informational design experts, such as Eduard Imhof, have developed. Some of these methods of evaluation are Layering and Separation of Data, Use of Color, and the ability to Describe Two Dimensions Simultaneously.
2.2.1.1 LAYERING AND SEPARATION

"Confusion and clutter are failures of design, not attributes of information. And so the point is to find design strategies that reveal detail and complexity- rather than to fault the data for an excess of complication. Or, worse to fault viewers for a lack of understanding" (Tufte 53).

People (Designers) tend to attribute confusion and poor layout of data in a display (or any design – in general) to the complexity and quantity of information rather than their own failures in the design. Moreover, designers tend to blame users for their lack of knowledge or inability to use or interact with the design rather than noting the failures in the concept and fixing them.

Layering and Separation is visually stratifying various aspects of data. Establishing the proper relationship among information layers is vital and will reduce noise and enrich content. The successful examples of layering and separation that Tufte evaluates use distinction in Shape, Value (light to dark), Size, Line Weight, and Color (Tufte 58). This means that using different shapes and sizes of objects or icons, different values from light to dark, different line weights from light to heavy and different colors are necessary for a successful visual display. The following are examples of unsuccessful and successful attempts at Tufte’s Layering and Separation theory.

Unsuccessful Example of Layering and Separation

Tufte uses the following example of a data display as a “failure in communication:” He states that in this example (Figure 2.1), “all of the elements—contours, rivers, roads, names—are at the same visual level with equal values, equal texture, equal color, and even nearly equal shape. An undifferentiated, unlayered surface results, jumbled up, blurry, incoherent, chaotic with unintentional optical art. What we have here is a failure to communicate” (Tufte 58).

This (Figure 2.1) is an example of poor communication in a visual display. In this example there is no distinction in shape or differentiation in value. Everything is in the same shade of black and there is no use of grayscale values or color. Along with no color or value differentiation, the cities and topography information are unclear, not spaced properly, and very difficult to read.
This data display does not follow Tufte’s Layering and Separation theory of using *distinction in Shape, Value (light to dark), Size, Line Weight, and Color.*

![Figure 2.1: Unsuccessful Example of Layering and Separation, (Tufte 58)](image)

**Successful Example of Layering and Separation**

In the next example (Figure 2.2), Tufte is a bit more optimistic. He states that this example “separates and layers information by means of distinctions in shape, value (light to dark), size, and especially color.” This example (Figure 2.2) is a more successful attempt at color separation and creating distinctive layers that are easily identified. In comparison to the previous example, the map works better with a dull or muted background versus a white background. The background does not compete with the important information and helps to avoid unnecessary...
clutter. Also, the variety of color and value help to differentiate between roads, water, buildings, and other important landmarks.

Figure 2.2: Successful Example of Layering and Separation (Tufte 58)
2.2.1.2 USE OF COLOR

Uses of color in Information Design are to label (noun), to measure (color as quantity), to represent or imitate reality (color as representation), or to enliven or decorate (color as beauty) (Tufte 81). This means for example, that color can be used as a label- to distinguish between a building and a street, to measure-to indicate altitude by using color change, to represent or imitate reality-using blue for water, and to decorate-visually enliven versus plain black and white display.

Figure 2.3 shows how color can label- blue for water, green for land; measure-indicating altitude by different values of black; represent or imitate reality-having blue color for water or black for shadows; decorate- color used to make map more sophisticated and visually pleasing (Tufte 81).

Figure 2.3: Use of Color Example: Swiss Mountain Map - Wabern, 1983 (Tufte 80)
According to Eduard Imhof in *Cartographic Relief Presentation*, the first two principals of color composition are:

"First rule: Pure, bright or very strong colors have loud, unbearable effects when they stand unrelieved over large areas adjacent to each other, but extraordinary effects can be achieved when they are used sparingly on or between dull background tones. 'Noise is not music. Only a piano allows a crescendo and then a forte, and only on a quiet background can a colorful theme be constructed.' The organization of the earth's surface facilitates graphic solutions of this type in maps. Extremes of any type--such as highest land zones and deepest sea troughs, temperature maxima and minima--generally enclose small areas only. If one limits strong, heavy, rich, and solid colors to the small areas of extremes, then expressive and beautiful patterns occur. If one gives all, especially large areas, glaring, rich colors, the pictures have brilliant, disordered, confusing and unpleasant effects.

Second rule: The placing of light, bright colors mixed with white next to each other usually produces unpleasant results, especially if the colors are used for large areas."

In summary, Imhof's basic rules to applying color are first- that bright colors work best on dull backgrounds, second- to limit strong/solid colors to smaller areas of display versus larger areas, third- placing bright colors next to white usually produces unsuccessful results. Imhof expressed that just because there might be color distinction, that doesn't mean it is successful color distinction. With the wrong placement of color, one can produce unpleasant results. One should follow Imhof's theories for successful color use and look to achieve color balance and harmony (Tufte 83).

*Unsuccessful Use of Color – based on Imhof’s color theory*

Tufte uses this example (Figure 2.4) as an unsuccessful attempt at using color properly. All of the colors used in this image are strong and equal in value. This image (Figure 2.4) breaks Imhof's first rule of placing strong colors of equal value next to each other. The colors struggle with each other rather than complement each other on the page. The thick band of color separating the areas distracts from the data and creates a loss of detail.
Successful Use of Color – based on Imhof’s color theory

Tufte uses this example as a successful attempt at color usage. The display follows Imhof’s rules of color composition because it contains a muted background with smaller color spots that are clearly identifiable. The display uses two different colors that do not blend or compete with each other. Also, the color is not cluttered or spaced improperly.
2.2.1.3 DESCRIBING TWO (OR MORE) DIMENSIONS SIMULTANEOUSLY

Success in describing two, or more, dimensions successfully is through correct layering and separation and effective use of color. The examples Tuft refers to are timetables and graphs that layer time and space. He describes many examples and the consistent themes that he expresses in successfully describing two or more dimensions are – layout directness, clarity of organization, and spatial relationship between the dimensions (Tuft).

Figure 2.6 shows how data can be displayed changing over time. Both charts consist of overlapping layers- the chart on the left overlaps some quantity of data changing over time and the chart on the right overlaps locations, dates and time (Tuft 104-7).

![Figure 2.6: Layering two (or more) dimensions (Tuft 104-7)](image)

Layout directness, clarity of organization, and spatial relationship between the dimensions, simply translate to this question, “is the visual display clear?” Is the display organized and how is it organized? Does the organization add to clutter or clarity? How do the different layers (i.e. time and space) relate and how are they integrated into the display visually?
All of these questions boil down to one major question- is there a hierarchy of information? According to most designers, information hierarchies are the cornerstone of good design and usability (Boag). Hierarchies are used to prioritize content in order of importance, add clarity to a design, and to create visual cues. No matter what is being designed whether it be a topological map or a website, the information needs to be organized into logical sections in order establish an importance of information. In fact, people don’t only use hierarchies to create logical separations in information displays, hierarchies are seen in everyday life. According to David Farkas of Principals of Web Design,

"humans naturally build coherence and order into our world by establishing categories and subcategories. We divide our planet into continents, nations, and smaller divisions such as provinces and states. We divide the animals and plants around us according to the categories of kingdom, phylum, etc...When we design traditional print books, we typically divide them into chapters, sections, and subsections" (Farkas).

In other words, hierarchies, in general, structure our lives. We are surrounded by hierarchies and the foundation of almost all good information systems is the result of a well designed hierarchy. Although there are many ways to structure hierarchies, Farkas explains that there are three basic types of hierarchies used to separate information in web design, a strict hierarchy, the secondary link hierarchy, and the converging links hierarchy.

![Example 1: A Strict Hierarchy](image)
The structure is defined by primary links. The primary links are distinct and obvious.
Example 2: *Secondary Link Hierarchy*

These links are separate from primary links and are often “secondary” to main aspects of the site such as a section on the page for “related links.”

Figure 2.8: Hierarchies, Example 2 (Farkas)

Example 3: *Converging Hierarchy*

This hierarchy has converging primary links. These links converge on a single child node so that the child has two parent nodes that are different. This may apply when a link has connections or relativity to two different areas of the website. Also this is done so that the user has multiple views and pathways to the same information.

Figure 2.9: Hierarchies, Example 3 (Farkas)

Based on the methods taken from Tufte and other Information Design experts, such as Jacob Nielsen, Richard Saul Wurman, and Eduard Imhof, I will analyze and evaluate existing interactive websites and 2D and 3D animated maps/displays in order to establish criteria for developing a successful interactive web prototype.
2.2.2 EVALUATING EXISTING INTERACTIVE WEBSITES AND 2D/3D ANIMATED MAPS

The purpose of this research is to explore different techniques used to successfully create interactivity and implement animation into a display. The different types of animation in a display are either 2D animation or 3D animation. In order to create a successful interactive web prototype and visual display, it is necessary to examine and evaluate existing displays that contain content that is similar to the content in this project. Examining these displays aids in identifying similar problems and in developing solutions to those problems. The displays evaluated are existing web interfaces and existing 2D and 3D animated maps. Moreover, the examples in this section were chosen because they consist of either interactivity with buttons and rollovers, 2D animated maps and/or 3D animated displays. I will evaluate what has been done before, what is successful and what is not successful based on previously stated expert theories and formulate criteria for my design solutions. The expert criteria that I will use to evaluate existing sites and maps will be:

- **Layering and Separation** – Does the display use distinction in Shape, Value (light to dark), Size, Line Weight (light to heavy), and Color?
- **Use of Color** – Does the display follow Imhof’s theories for successful color use and is there color balance and harmony?
- **Describing Two (or more) Dimensions Simultaneously** – Is there a hierarchy and does that hierarchy add clarity to the information and design (hierarchy), is there layout directness, clarity of organization (clarity or clutter), and spatial relationship between the dimensions (overlapping time and data)?

2.2.2.1 INTERACTIVE WEBSITE - EXAMPLE 1:

Interactive Website: *Center for Agricultural, Resource and Environmental Systems*, University of Missouri –Columbia: [http://www.cares.missouri.edu/animation/animation10_sw.html](http://www.cares.missouri.edu/animation/animation10_sw.html)

*Site Overview:*

This website serves The Center for Agricultural, Resource and Environmental Systems (CARES). CARES is “an intercollegiate research and education center within the College of
Agriculture, Food and Natural Resources at the University of Missouri – Columbia. CARES was established in 1992 with the purpose of helping people better understand and address agricultural, natural resource and environmental issues using knowledge and information technologies" (http://www.cares.missouri.edu/cares/about/index.html).

This site displays interactive maps, atlas maps, and analysis and modeling of specialized scenarios such as the Environmental Sensitivity Index Tool (ESI), which is a method of ranking local watersheds by their environmental sensitivity. The map reviewed is the Animated Time Series Maps - Population Density 1900-1990 (Figure 2.10) (CARES).

The Population Density 1900-1990 map (Figure 2.10) calculates the persons per square mile by county for the entire state of Missouri. The user has the option to view the map of Missouri from three different directions: from the southwest, from the south, and from the southeast. Once the user chooses a direction, they are taken to a page that lets you select a year and a county. Once this is selected it automatically takes me to a static table of data on population density for the years between 1900 and 1990. Back on the main page the user can also select their “run animation” button and it will display the data model and timeline change over time.
• **Layering and Separation: Distinction in Shape, Size, Line Weight and Color**

As shown in Figure 2.11, the animated 3-dimensional data bars are very descriptive and let the user visualize the population growing over time with a sense of volume and relationship to each other versus flat models with no spatial qualities. The integration of the timeline in the corner also helps to describe the progression of the 3-dimensional data bars.

This site uses color very well to represent data. Although it is on a very white background, the small amount of color for the purpose of standing important data ahead of the rest works well (Imhof's Second Rule). The use of different line weights is apparent in the very thin line weight in the 2D county map and the heavy line for the timeline. Also, font weight was taken advantage of with a lighter weight for the mass information and a bold font for the map data.

• **Use of Color: Color balance and harmony**

Although the site used color well to represent and compare data (Figure 2.12), it is lacking in color harmony. The palette that is used is large and consisting of bright greens, blues,
yellows, oranges, reds, and blacks. The shades of the colors vary from very bright to very dull tones. Although the site may lack in color harmony, the larger palette does serve its purpose of representing the different content of the display effectively. For example in the 2D view animation, the palette is bright, in the 3D views the palette is dull, and in the Population Density diagram the palette is a mixture of the two (Figure 2.13). This may work well to distinguish between animations but doesn’t work well to establish harmony between the colors (Imhof’s rules). The bright blues and bright reds are also confined to small areas and help to stand out important information but again serve as a functional purpose only. In summary, the palette established in this site serves its purpose of using color to represent different data (Tufte, Color as Representation) but does not help to establish effective color balance and harmony on the page.

Figure 2.12: CARES Animated Time Series Map - Use of Color to Represent Data

- Describing Two (or more) Dimensions Simultaneously: Hierarchy, Clarity or Clutter, Successfully Overlapping Layers

The entire site fits under the Secondary Link Hierarchy system. There are primary links but also secondary links on each page (Figure 2.13). Once you are viewing the animations, graphically, the page is set up into three columns with horizontal rows on top and bottom. Instinctively, the eye is drawn to the center of the page but after that the eye is immediately drawn to the bright red spot on the page. After that, there is no visual cue or graphic hierarchy on where the user should go next (Tufte and Farkas, Hierarchies). Selecting a year and a county
takes the user to a static page of data, but the user then has to back up to click on the “run animation” button. As far as function goes, there is really nothing to let the user know what the he/she should do first. The timeline works in coordination with the 3D view in the middle of the page and the 2D view that is above the timeline. There is also a “full view” to the left of the “main view” which is moving as well. All four, the full view, the 2D flat view, the 3D data bars and the timeline run at the same time which makes it confusing to know which animation the user should be viewing (Figure 2.13). Although there is a hierarchy for the site, the page lacks in a successful layout and/or hierarchy.

Figure 2.13: CARES: Primary and Secondary Links and multiple animations running at once

Overall the page is laid out cleanly. The page contains a grid structure, which is necessary to establish a hierarchy of information and to successfully design the layout of the web page. Grid structures are used to logically split up a specific area into sections based on data and/or materials that are placed into those sections. The grid for this web page contains rows and columns that separate the visuals, links, and written text. Although there is no visual importance to one column over another, the cleanliness of the page helps to distinguish between animations.
and data and avoids "information overload." The columns are fairly distinct but the graphics do appear as if they were just "placed" on the page rather than laid out with a purpose. In Figure 2.14, it is evident that some of the graphics are overlapping into different columns and appear as if they were placed there indiscriminately during the layout of the page.

![Figure 2.14: CARES: Column and Row Separation](image)

The two layers that are overlapped in this site are population and time. Clearly, the population blocks do change size over time indicating population growth. However, the timeline is separate from the animation and seems, again, to be placed there indiscriminately rather than integrating the two graphically. Also, when the user runs the animation there are multiple diagrams moving at the same time, the full view, the main view, the 2D view, and the timeline (Figure 2.13). It becomes difficult to view all four at once and so the user has to pick and choose which animation to watch which can have positive and negative effects. The positive aspect is that the user has the choice to watch the view he/she is most comfortable. The negative aspect is that the user might miss valuable information because of a personal preference in color or angle of data.
2.2.2.2 2D ANIMATED MAP - EXAMPLE 2:

2D Animated Map: Rainfall Changes in the Sahel region of Africa: A Hypercard Animation of Surface III Contour Maps by Zale Schafer:
http://maps.unomaha.edu/Peterson/methods/Research/Zale/sahelview.html

Map Overview:

The purpose of this animated map is to illustrate the potential of animation as an analytical tool. It was created with the use of “Hypercard, a predecessor of html, that allows map makers to create frame-based animations of maps, text, graphs, and photos, with interactive "buttons" that allows users to control the display of the animation” (Schafer).

The animated map of the Rainfall Changes in the Sahel region of Africa is a linear animation that describes the rainfall by inches from the years of 1925 to 1975. The animation starts with a title and description page, and then moves to a page where the user appears to have the option to choose between two different maps or to quit. Even though these options are on the page, the animation moves on to the animated maps. The maps are black and white and show the rainfall changes over time throughout the region. Once the two maps have run, the animation loops back to the title page and runs again.

Figure 2.15: Screen shot of Rainfall Changes in the Sahel Animation (Schafer)
• **Layering and Separation: Distinction in Shape, Size, Line Weight and Color**

Because of the software used to create this animation, Hypercard, the display is not interactive. The animation serves the purpose of being an example of advanced cartographic methods; however, graphically it is plain. As shown in Figure 2.15, the animation contains hatching to distinguish the different levels of rainfall. Other than the extreme ends of the scale, all of the values of the levels converge together and it is difficult to tell the difference between forty and eighty inches of rain. This is due to the shape, size, and weight of the lines used in this range (forty to one hundred inches of rain). The display contains similar shapes, has very little difference in density of hatching (size and weight), and the lines are all black and white with no color to aid in distinction (Tufte) (Figure 2.15).

• **Use of Color: Color balance and harmony**

Color is not used to represent any data; everything is in black and white (Figure 2.15). The different levels are represented with different values of black or the density of the hatching but when looking at any levels of rainfall that aren’t at the extreme ends of the scale, the values become hard to distinguish (Figure 2.15).

• **Describing Two (or more) Dimensions Simultaneously: Hierarchy, Clarity or Clutter, Successfully Overlapping Layers**

The site’s purpose is to display this map animation project. The animation is laid out effectively on the page with a timeline at the top of the page and rainfall legend to the left. The hierarchy is simple but clean (Figure 2.15).

The layout of the three parts, the animation, the timeline, and the legend are clear and distinct (Figure 2.15). There is no text or an overload of graphics to clutter the page; however the patterns, density, and size of the hatching really does add clutter (Tufte) in the animation itself (Figure 2.15).

The linear animation’s pace is too fast. The user isn’t given enough time to digest what he/she is seeing and there is no way to control what the user is seeing. Once the intro loads, the
user has about 2-3 seconds to read it all and if he/she hasn’t, the information is missed. However, during the amount of time that the user has to view the animation, it’s obvious the two layers that are being overlapped are rainfall levels and time. The timeline works well with the animation and although there are negative aspects to the hatching, the legend is effective as well. With the timeline being positioned at the top of the animation, it was easy to view the animation and glance at the timeline for reference.
2.2.2.3 3D ANIMATED MAP - EXAMPLE 3:

3D Animated Map: *Predicting the Impact of Climate Change on Glacier and Vegetation Distribution in Glacier National Park to the Year 2100* by Myrna Hall, 1994:  
http://www.nrmse.usgs.gov/research/glacier_model.html

*Map Overview:*

The purpose of this animated map is to show the effects of “global warming” on a portion of Glacier National Park over the time period from 1850 to 2100. This project was supported by the Global Change Research Program -- U.S. Geological Survey, Northern Rocky Mountain Science Center (Hall).

The animated map is a linear animation of the change in landscape over time. The only interactivity slows the animation down. The animation consists of a mesh 3D landscape with color-coded areas that are changing as the year is increasing from 1850 to 2100.

![Screen shot of Hall's Climate Changes over Glacier National Park](image)

*Figure 2.16: Screen shot of Hall’s Climate Changes over Glacier National Park (Hall)*
• *Layering and Separation: Distinction in Shape, Size, Line Weight and Color*

As shown in Figure 2.16, the animated map is very distinct in shape and allows the user to view the specified area of Glacier National Park in a three-dimensional view. The animation consists of different colors that represent different types of topography from grassy areas to rocky areas (Tufte, Color as Representation/Label). The colored areas are clear and effectively represent the different topographies. The line size and weight follow the topography, which also aids in differentiating between the different types of ground cover.

• *Use of Color: Color balance and harmony*

The color palette used in this display consists of white, grays, oranges, yellows, reds, greens, and blues. All of these colors stand out well from the black background and from each other. As the animation runs, the colors become representative and/or imitate reality (Tufte) such as white representing glaciers and blue representing lakes in the area. Although there are finely detailed areas with lots of pockets of different color, overall, the colors chosen compliment each other nicely and create color balance and harmony (Figure 2.17).

![Image](image.png)

Figure 2.17: Climate Changes over Glacier National Park: Finely Detailed Areas of Color (Hall)
• Describing Two (or more) Dimensions Simultaneously: Hierarchy, Clarity or Clutter, Successfully Overlapping Layers

Although the animation and color scheme is effective, there is still a lack of hierarchy on the page (Tufte and Farkas, Hierarchies). Problem areas do exist, as shown in Figure 2.18, such as the 2D legend covering up a portion of the 3D animation and not being integrated graphically. Also, the sponsor logo is in bold text and seems to have priority over the changing year and the 2D legend. Because there isn’t an abundance of text or miscellaneous graphics, the lack of hierarchy doesn’t add clutter to the display (Tufte, Clarity or Clutter). Overall, the display is clear and effective.

There are three layers being overlapped in this display, location, land type, and time. The timeline is simple but effective. There are no moving parts, other than the years being replaced from frame to frame, to distract from the main landscape animation. Although the animation integrates multiple factors fairly well, the relationship between the time display and map and the legend and the map seems not to be a fully integrated one. It seems that the time display and the legend weren’t incorporated into the design, just added for reference (Figure 2.18). This takes away from the display’s overall success.

Figure 2.18: Climate Changes over Glacier National Park: Problem Areas (Hall)
Exhibit Overview:

At the Ohio Historical Society in Columbus, Ohio, there is an exhibit titled *The First Ohioans* (Figure 2.19). The purpose of this exhibit is to explain all of the different American Indian groupings from the Palaeo-Indian era to the Mississippian Indian era. The exhibit contains a combination of scale models and posted literature that explains changing topography through time, where these Indians lived throughout Ohio, and how they lived (Figure 2.19). It displays how the Indians followed game such as mastodons, mammoths, elk, caribou, and buffalo. It displays artifacts found such as tools and arrows that they made from flint and other natural resources, and also discusses the major mounds such as Serpent Mound, near Sinking Springs, Ohio.

![Image of the exhibition](image-url)

Figure 2.19: OHS Exhibit: Entrance and Full-Scale Models in Exhibit

Exhibit Evaluation:

- *Layering and Separation: Distinction in Shape, Size, Line Weight and Color*

As shown in Diagram Figure 2.19 and Figure 2.20, the exhibit contained models that successfully represent chain of events through time such as the formation of Ohio topography or
how the American Indians hunted caribou. The scale models were very distinct in size, shape, and color (Tufte), which made them successful and clear. In Figure 2.19, the models and scene was created in full scale in order to create a sense of reality for viewer. The shape and colors for each model was realistic and identifiable. Each exhibit was separated into its appropriate section and was evident that a layout had been established.

Figure 2.20: OHS Exhibit: Scale Model of Topography of Ohio and American Indians Hunting Caribou

• Use of Color: Color balance and harmony

Almost all of the small scenes such as the one shown in Figure 2.21 contained realistic color representation and were effective at creating visual cues for the viewer. The objects, people, and animals were clearly identifiable and color played a large part at keeping the scenes interesting. Grassy areas, trees, and trails were represented in the scale models with the use of realistic color (Tufte, Color as Representation) and scale. The individual maps also used color to represent different areas of land and American Indian groupings. These colored areas distinctly identified the locations of different Indian groupings and locations of settlements.
Describing Two (or more) Dimensions Simultaneously: Hierarchy, Clarity or Clutter, and Successfully Overlapping Layers

The exhibit was laid out in a linear fashion so the Palaeo-Indian groupings were displayed first, the Archaic Indians, then the Woodland Indians, and lastly the Mississippian Indians. It was clear the hierarchy for the exhibit was in chronological order of events. Although the layout was clear, it was hard to digest all of the information and difficult to remember what you had seen because of the complexity of the information (Figure 2.22). For instance, by the time the viewer gets to the Mississippian Indians section, it is very possible that the viewer has forgotten the order of groupings that were previously viewed and how those previous groupings relate to the current group being studied.
The major layers that are overlapped in this exhibit are different Indian groupings, topography, and time (Tufte). The exhibit was long and confusing because every model was segmented and only focused on one issue at a time such as topography, tools used, hunting techniques or culture (Figure 2.23). There wasn’t any cross-referencing and few pieces of visual imagery other than the scale models. In Figure 2.23, it is easy to see the layout of the exhibit itself was like a maze and this made it difficult to focus on the information. Because of the exhibit layout and the segmentation of the visuals, it was difficult to visualize how one layer influenced another such as how the changing topography influenced everyday life.
2.3 ESTABLISHED DESIGN CRITERIA BASED ON RESEARCH ON EXISTING SITES, ONLINE MAPS, AND OHS EXHIBIT

In conclusion, the research for this project consisted of analyzing existing websites, two dimensional and three dimensional displays based on methods learned from Information and Web Design experts such as Tufte and Farkas. Most of the displays examined consisted of either topological maps, weather maps, population maps, or maps that consist of data changing over time. From the sites, maps and exhibits that I evaluated, I learned the following:

1. Hierarchies are vital in organizing information and are necessary in viewer direction and comprehension- Based on expert theory, hierarchies have a large impact on the clarity of the information and/or display. Most of the displays evaluated lacked in organized hierarchies for the visual content in the display. Although, some web pages and displays did appear to have a typical grid structure, often the grid did not correspond to the importance of the graphics.

2. Animation serves as an effective tool for communication when overlapping multiple layers- In looking at the animations alone, most of the animations studied were clear and served their purpose. Other than timing issues, most animations were successful and helped to visually communicate the overlapping layers involved such as in Figure 2.16, which shows how the land in Glacier National Park is changing over time. After studying flat-static displays and moving displays, I came to the conclusion that when layering complex issues such as people, locations and time, static layouts become confusing. Moreover, using time as descriptive element provides a better understanding of transformations between the layers. The moving displays took less time to comprehend, were more descriptive and enjoyable, and enabled the designer to layer complex data that might otherwise not be communicated in static displays.

3. Cross-referencing is vital for the user to be able to digest multiple theories that influence each other- In the displays evaluated, the timelines in combination with other animations seemed to establish a relationship between the layers of a project no matter how the project was presented. The timelines established a time reference to events, which was helpful to put events into perspective and to compare and contrast events.

4. Color-coding is necessary and especially helpful for moving parts- In most of the
two-dimensional and three-dimensional displays, color-coding was helpful in making distinctions between different shapes and areas of the displays. Color-coding was particularly helpful when areas of the displays had multiple objects moving simultaneously. The different colors helped to establish relationships between those areas in the display.

5. An appropriate blend of simplistic and sophisticated graphics is necessary to help eliminate “information overload” and to simultaneously create a pleasing design aesthetic. Most of the displays studied were more like the previously shown, Figure 2.15. Most of the displays were flat, two-dimensional displays like this example. Of the selected three-dimensional displays studied, most consisted of simplistic objects like primitives for bar graphs, etc. This idea is displayed in Figure 2.10 where primitive cubes are used to show population rising. These simplistic graphics can have positive and negative aspects to the design. The positive aspect is that is clear and concise and will not create “information overload.” The negative aspects are that it is simple and boring. In Figure 2.16, the three-dimensional mesh landscape is interesting and uses a combination of shape and color to create a successful solution to show land changes versus a flat model that has simple primitives that change over time.

6. Limiting the amount of simultaneous moving parts may eliminate confusion for the user - As in Figure 2.10, too many animations running at once becomes confusing for the user. In this Figure, three animations plus the timeline are running simultaneously. It becomes difficult to watch all three animations at once and if the user picks and chooses, the user will have to watch the animation multiple times to absorb all of the information. This is problematic because if the user chooses not to watch it multiple times, he/she might miss out on valuable information that is necessary to understand the project. Also, when viewing the animations the user is sidetracked by the other moving parts on the page and this can lead to confusion of the data.
This project follows expert theory in order to develop successful visual displays. The Design Research phase establishes a set of design criteria for developing successful solutions for projects with a similar scope. The following are the design criteria followed in this project:

1. *Hierarchies are vital in organizing information and are necessary in viewer direction and comprehension.*
2. *Animation serves as an effective tool for communication when overlapping multiple layers and time.*
3. *Cross-referencing is vital for the user to be able to digest multiple theories that influence each other.*
4. *Color-coding is necessary and especially helpful for moving parts.*
5. *An appropriate blend of simplistic and sophisticated graphics is necessary to help eliminate “information overload” and to simultaneously create a pleasing design aesthetic.*
6. *Limiting the amount of simultaneous moving parts may eliminate confusion for the user.*

The intent of this project is to follow these design criteria to problem solve the visual design project of explaining the development of early roads over time in the Midwest. The pertinent kinds of information that need to be shown in this project is:

- The Midwest geographic region
- Examples of early Indian and Military trails
• Examples of development patterns of early roads and modern roads
• Examples of early settlements.

In order to display this information successfully, I will divide the project up into three parts:

A Moving Map Display- The content of the moving map display contains computer animation to show the process of how, over time, trails were formed and how those trails became major roads and highways throughout the Midwest, specifically in Ohio. Ohio was chosen as the focus of my research because I, personally, have traveled on the still existing early roads that played a major role in the development of modern highways throughout the Midwest. This map shows the development patterns and locations of roads and shows the locations of early settlements in Ohio and surrounding areas.

This design solution (Moving Map) was chosen in order to take advantage of the ability of animation to layer and cross-reference pertinent material to better communicate the necessary information and to aid viewers make connections between seemingly unrelated parts.

Virtual Environment Display- The content of the Virtual Environment uses Virtual Reality Markup Language (VRML) to show the early settlement of Chillicothe, Ohio during the 1800’s. Chillicothe was chosen because it was the first settlement in Ohio and also the first capital in Ohio. The Chillicothe Courthouse is the main focus in the environment because it played a large part in history as it was the location of the signing of the Ohio Constitution during the 1800’s.

A VRML environment was chosen as a design solution because it allows the user to navigate through the environment and creates user control over the display. It also immerses the user and provides a three-dimensional representation of what the environment and Courthouse might have looked like during the 1800’s.

Three-Dimensional Road Development Animation- The content in the three-dimensional animation displays trail to modern road development in a linear fashion. It also represents what topography might have looked like in a specific area and displays modes of transportation for the different time periods.
This three-dimensional piece was chosen as a design solution because it displays how modern roads evolved from narrow Indian trails and enables the viewer to visualize the transformations and connections between the different time periods. The animation allows the viewer to receive a realistic and identifiable three-dimensional representation of the topography, roads, and modes of transportation with different viewpoints rather than simple images, sketches, or flat animations.

In order to successfully create these three visual displays, it is necessary to develop solutions that follow the previously established design criteria. The displays need to contain hierarchies that will prioritize information and create visual cues for the user (design criteria #1). They will contain animation to take advantage of the ability to cross-reference and layer multiple dimensions (design criteria #2 & #3). The displays will be color-coded to separate sections and to create balance in the display (design criteria #4). A combination of simple graphics with more sophisticated topological maps will exist to aid in functionality and aesthetics (design criteria #5). Also, the displays will eliminate confusion and create user control with the use of linear animation and a virtual environment (design criteria #6).

3.1 MOVING MAP INTERFACE

The moving map is contained in an interface and overlaps influential factors such as geographic location, roads, and time through the use of animation. It visually describes the development and direction of the first road in Ohio, Zane's Trace starting with Native American Indian Trails and Military Trails (Chapter 7: Historical Content and Research, Figures 7.1 and 7.2). The moving map demonstrates how Zane's Trace influenced the path of The National Road (Chapter 7: Historical Content and Research, Figure 7.4) and how the National Road influenced US 40 and later I-70 (Chapter 7: Historical Content and Research, Figures 7.9-7.11). This information overlays a topography map of the United States (Figure 3.1). This background map is used as a reference and base for overlaying the animation. It was found in the Map Library located in the Main Library at The Ohio State University. Sections of the map were cropped in order to display the appropriate areas of the Midwest (Figure 3.1).
The moving map runs in coordination with a timeline in order to create a time reference for the user. The moving map and timeline will house the other detailed displays that are representative of the topography of that area and time, and trail to road evolution. These displays will cross reference the moving map and timeline so the viewer always has a sense of where and when the scene takes place either by layering visuals or by structuring scenes in coordination with each other so the mental relationship can be made.

The most important part in developing the moving map is establishing the hierarchy of information to be included in the map (design criteria #1). This includes laying out the content of the map and also includes developing flow and graphics of the map and interface.

Figure 3.2 describes all of the important historical factors that were influential in the making of Zane’s Trace and also establishes a hierarchy of information, which is vital the foundation of almost all successful information systems according to Farkas in Principals of Web Design. At the top of the hierarchy is the main event, the building of the first road in Ohio, Zane’s Trace. The influential factors in the building of the road includes introducing the periods of time that included Native American Indians, Explorers, and Settlers. It also includes the evolution of the Trace, the development of the National Road and how that influenced the movement west.
Figure 3.2: Schematic #1-Content Structure

Figure 3.3 is a more refined layout similar to the first but focuses on the important events that should be the main focus of the map. Each main event, along the centerline in the middle of the diagram, has subsections that could be included into the project such as a “historical documents” subsection under the “National Road” section. The main events are placed into the appropriate time periods for reference with the use of a timeline placed at the top of the page.
Figure 3.3: Schematic #2-Refined Content Structure

Figure 3.4: Schematic #3-Site Map
Figure 3.4 is a refined site map that describes the necessary linear hierarchy of information included in the interface. The primary chain of events focus on the Old Northwest Territory, then moving into Ohio, show important Indian Trails and Military Trails, early routes in Ohio, show the development of Zane’s Trace, the National Road, US 40, and I-70.

Figure 3.5 starts to overlap time and the final linear chain of events. The final time span is moving from the 1700’s to the mid 1900’s and also semantically represents the movement west. The animated map displays above and corresponds to the timeline. All of the initial pertinent information (Midwest geographic region, examples of early Indian and Military trails, examples of development patterns of early roads and modern roads, and examples of early settlements) is cross-referenced in the animation and timeline (design criteria #2 & #3). Also as seen in Figure 3.6, all of the different sections in the timeline are color-coded to signify change and road designation (design criteria #4). While the animated map is running, simple primitives will represent trails, roadways, and locations that correspond to the timeline (data from Chapter 7: Historical Content and Research). These simple graphics are complimented with a more
sophisticated topological map (Figure 3.1) of the Midwest region and Ohio (design criteria #5). With the use of color-coding (Figure 3.6) and proper timing of the moving parts, the animated map does not consist of more than two parts moving simultaneously (design criteria #6).

![MAP ANIMATION WILL RUN ABOVE TIMELINE](image)

Figure 3.6: Schematic #5- Color-coding and Section Separation in the Wire-frame Interface Layout

As previously shown in Figure 3.5, the moving map will house the other visual displays. The virtual environment can be viewed if the user goes to the section “Early Settlements and Towns.” After the user clicks on this link, a page displays in the map animation area and a graphic, which changes size or shape, acts as a “hotspot” or a link that the user can select to view the virtual environment. This “hotspot” provides the user with a visual cue that he/she has the option to view another display. If the user clicks on the “Zane’s Trace” link, different visuals appear in the map animation area and there is also be a “hotspot” that the user can select to view the 3D animation on roadway development.
3.1.1 VIRTUAL ENVIRONMENT – THE CHILLICOTHE COURTHOUSE

The purpose of the virtual environment is to recreate the original Chillicothe Courthouse that existed in the early 1800’s (Figure 3.7). As previously discussed, Chillicothe was chosen because it was the first settlement on Zane’s Trace and also the first capital in Ohio. The Chillicothe Courthouse was dismantled in 1852 and no longer exists but played an integral role in Ohio’s history while Chillicothe was the early capital of the state.

![Virtual Environment Layout](image)

Figure 3.7: Virtual Environment Layout

The Courthouse is the main focus in the environment since it played such a large part in Ohio history. The virtual environment is representative of the environment surrounding the Courthouse in the mid 1800’s. A VRML environment was chosen as the medium because it allows the user to navigate through the environment and creates user control over the display. The display contains navigational toolbars that the user can select to pan, roll, and turn through the environment. The display depicts hilly terrain, trees, a wagon road, and the Courthouse with surrounding barns (Figure 3.8).
As seen in Figure 3.7, the virtual environment is representative of images and sketches of the dismantled Chillicothe Courthouse (Figure 3.8). The environment is displayed in a browser using Cortona software made by Parallel Graphics (http://www.parallelgraphics.com). Cortona is made for viewing 3D models on the web and works as a VRML plug-in for Internet browsers such as Internet Explorer and Netscape.

The interface contains a grey area around the environment, which houses a set of navigational toolbars that the user can use to navigate through the environment. This grey area creates separation and organization within the display and creates visual cues for the user on how to navigate through environment (design criteria #1). Also, the models in the environment cross-reference topography for that area, means of travel, and early settlements (design criteria #2 & #3). The environment is represented with sophisticated graphics and with realistic textures and colors that separate objects and make them clearly visible and visually pleasing (design criteria #4). The objects in the environment are easily identifiable and are not cluttered with unrecognizable graphics (design criteria #5). While navigating through the environment, the user has a first-person perspective, which immerses the user into the activity and allows them to move at their own pace and understand the purpose of the display (design criteria #6).
Figure 3.9: Integration of Virtual Environment into the Moving Map

Figure 3.10: Virtual Environment in a separate browser window
The virtual environment display is accessed through the moving map. As previously discussed, when the user selects “Early Settlements and Towns,” a visual showing the locations of early settlements and towns on Zane’s Trace appears (Figure 3.9). In this visual, a “hotspot” flashes as a visual cue for the user to select it to view the virtual environment (Figure 3.10). Once this hotspot is selected, the virtual environment will display in a separate browser window (Figure 3.10). The new window is created for user convenience so the user does not lose their place in the map interface and does not have to use another link to return to the main display.

3.1.2 ROAD DEVELOPMENT ANIMATION

The Road Development Animation is a three-dimensional animation that describes how roads evolved from animal trails – to rugged Indian trails – to wider wagon trails (explorers) – to even wider, more refined roads (settlers). The animation is set in southeastern Ohio and is referenced from images taken from this area on Zane's Trace, which still exists today. The piece is also representative of what topography looked like in southeast Ohio from the 1700's to the early 1900's and will display trees, vegetation, and hills.

The purpose of the 3D animation is to take advantage of the ability to layer and cross-reference pertinent material such as what topography might have looked like for a specific area, different generations of animals and people who used the land, and time. The piece also offers more sophisticated graphics than other static mediums and 2D animations, and will communicate to the viewer the importance of the trails and the process of how roads and routes began in the Midwest over time, based only on visual material and sound. The 3D animation also engages the viewer with realistic and identifiable three-dimensional representations of the topography, roads, and modes of transportation with different camera viewpoints, which they cannot receive looking at flat animations, static images, or sketches. Having this three-dimensional representation aids the viewer in visualizing the transformations and connections between the different time periods. The 3D animation is approximately one and 1/2 minutes in length.

The first phase in creating the animation is storyboarding initial ideas. Before storyboarding can be done, reference images need to be gathered and examined in order to
correctly depict the different time periods (Figures 3.11, 3.12, 3.13). Reference images are needed for the roads, and anything that may have traveled on the roads such as wagons, and cars.

![Image of Damaged National Road in Indiana](image1)

*Figure 3.11: Reference Image of Traveler on the Damaged National Road in Indiana (Schneider 31)*

![Image of Typical Section of Wagon Road](image2)

*Figure 3.12: Reference Image of Typical section of the wagon road (National Road Museum Zanesville, OH)*
Storyboarding Initial Ideas

In order to successfully show the evolution of roads from animal trails – to rugged Indian trails – to wider wagon trails (explorers) – to even wider, more refined roads (settlers), a storyboard must be created. As shown in the early storyboard layout (Figure 3.14), each frame in this early storyboard represents a main event in the animation. The animation starts with a present day image of Zane’s Trace (1). The camera rotates and the animation appears to be going back in time with a tone change from a color picture to a black and white picture (2-3). The trees start to evolve, demonstrating that the area was covered in forest (3-8). A deer appears grazing in the wooded area and walks past the camera (9-10). The camera turns to the left and follows the deer as it disappears in the distance (11). From the left, a Native American Indian walking his horse fades in and walks past camera (12-13). The camera turns to the right as the Indian and his horse fade away into the distance (14). Just as the Indian fades, a Conestoga Wagon appears and moves from right to left in the screen (15-16). The camera follows as the wagon fades out down the road (16). From the left a Model-T appears and zooms from left to right as the camera follows (17-19). Over the whole animation the terrain changes from wooded to semi-wooded area as the roads develop and become wider.
Figure 3.14: Early Animation Storyboard Layout: Early Layout of Main Key Frames
The 3D animation is also accessed through the moving map. This animation will be contained in the "Zane's Trace," link (Figure 3.15). When this link is selected, a visual showing the location and direction of Zane's Trace appears. In this visual, a "hotspot" flashes as a visual cue for the user to select it to view the 3D animation. Once this hotspot is selected, the animation runs in a separate browser window similar to the virtual environment (Figure 3.16).
Visual showing Zane's Trace with a "hotspot" for 3D road development animation

Figure 3.15: Integration of 3D animation into the Moving Map

Figure 3.16: 3D Animation will run in new browser window
CHAPTER 4

DESIGN EXECUTION

4.1 MOVING MAP INTERFACE

Since the initial designs for the visual displays follow the design rules #1-3 of the previously established design criteria, which are:

1. Hierarchies are vital in organizing information and are necessary in viewer direction and comprehension.

2. Animation serves as an effective tool for communication when overlapping multiple layers.

3. Cross-referencing is vital for the user to be able to digest multiple theories that influence each other,

the next phase in the design process is creating the displays and finding successful solutions that follow design rules #4-6, which are:

4. Color-coding is necessary and especially helpful for moving parts.

5. An appropriate blend of simplistic and sophisticated graphics is necessary to help eliminate “information overload” and to simultaneously create a pleasing design aesthetic.

6. Limiting the amount of simultaneous moving parts may eliminate confusion for the user.

After developing the layout and hierarchy from the early ideation phases of the moving map and defining the integration of the virtual environment and the 3D animation, the next step is to define graphics in the visual displays. This includes content location, colors, and fonts for the moving map and interface, and defining final environment and 3D animation layout and aesthetic.

The following figures are the initial layout, refined layouts, and color tests for the moving map:
Figure 4.1: Initial Wire-frame Interface Layout with Color-coded sections

Figure 4.2: Refined layout, initial color tests
Figures 4.1 and 4.2 were initial layout and color tests. Figure 4.2 was constructed to evaluate how a black background would work with different colored sections. It also tested the map location and how it should be integrated into the interface. The design would offer a section to the left for more historical information, links, or instructional directions. After reviewing these trials, it was evident that the color-coded sections should not compete with a black background and the map viewing area wasn’t large enough to comfortably view the data being displayed, therefore the map should be as big as possible in the window.

In Figure 4.3, a muted background was used and produced favorable results. This muted background offered more flexibility with color selection for the separate sections. Although the color choices were more favorable, the map was still too small in the display.

Figure 4.4 is a more finalized layout and color scheme. The colors chosen in this layout needed to be distinct enough to separate the sections but at the same time create balance and
harmony on the page (design criteria #4). This proved to be a problematic factor (which is solved in the Design Refinement phase of the project)- finding the proper color scheme that was balanced and at the same time distinguished different sections of the timeline as they are overlaying each other on the map. This layout also integrates a more sophisticated map that is much larger in the display. This map compliments the simple graphics in the timeline, which will aid in the usability of the display (design criteria #5). The Timeline Layout below shows that additional historical information can be found after rolling over the links in the timeline. This design offers more interactivity without overloading the user with moving parts, which may cause confusion (design criteria #6).

Figure 4.4: Implementation of a More Sophisticated Map and Distinguishable Colored Sections
The moving map and timeline was created using Macromedia's Flash MX. Flash was chosen to take advantage of the ability to layer information and create interactivity within the display. In the timeline, the display contains seven different sections that when rolled-over will display historical information. For example, in the Timeline Layout above (Figure 4.4), the historical information for The National Road appears as the user rolls-over the yellow area with their mouse. This information acts as an aid to better understand the display and to provide the user with a broader knowledge of the historical content presented. While the animation is running above the timeline, the timeline moves from right to left, semantically representing the movement west. The timeline also provides the user with a time reference for the events taking place.

4.1.1 VIRTUAL ENVIRONMENT – THE CHILlicoTHE COURTHOUSE

The final placement of Virtual Environment Display image (Figure 4.5) demonstrates the final location for the virtual environment display in the moving map. The environment is contained under the “Towns” link and is represented with a flashing “hotspot” that the user can select. This section of the timeline is represented by the color Green and will display all early towns as Green icons on the map. The “hotspot” will be Green as well and once selected, the display will open in a new browser. As previously discussed, the new window is created for user convenience so the user does not lose their place in the map interface and does not have to use another link to return to the main display. The following are images from the final virtual environment.
Figure 4.5: Final Placement of Virtual Environment Display

Figure 4.6 demonstrates the users starting point once the environment is loaded into a new window. The user is put on a path, which represents what a wagon road might have looked during the 1800's. Figure 4.7 demonstrates different viewpoints and models in the scene. The user is able to put their cursor over the trees and other objects in the scene in order to move to different viewpoints in the scene. When the user puts their cursor over a specific object in the scene, the cursor will change from an arrow to a hand to indicate a “hotspot” or link to a different viewpoint in the scene.
Figures 4.6 and 4.9 show the Courthouse. When the user is navigating through the environment, he/she is able to put their mouse over the Courthouse and click to go to a website.
that has historical information about building and surrounding area. Upon selection, this site appears in a new browser window for user convenience.

Figure 4.8: Screen capture from Final Virtual Environment: Different Viewpoint

Figure 4.9: Screen capture from Final Virtual Environment: Close-up of Courthouse
Figures 4.10 and 4.11 demonstrate the ability to view the environment from different areas and angles.

Figure 4.10: Screen capture from Final Virtual Environment: Behind Courthouse

Figure 4.11: Screen capture from Final Virtual Environment: Courthouse and Wagon
In the environment there is the main Courthouse building with some surrounding structures. The scene also consists of trees, hilly terrain, and a Conestoga wagon with horses. The environment was built using several different software applications, which included Alias|Wavefront’s Maya software, VRML, and Terragen (Figure 4.12). All of the models (except the sky - skybox) were built, textured, and exported into VRML using Maya and a text editor.

**Figure 4.12: VRML Environment Design Process**

The skybox was created using Terragen, a scene generator made by Planetside Software. Using Terragen, I created a scene that was hilly, green and vast. After creating the scene, I placed the camera and rendered out frames at 0°, 90°, 180°, and 270°. All of the camera angles had a 0 pitch angle in order to guarantee that they would match up. Then I placed the camera back at 0° and changed the pitch to 90 to render out the top of the skybox. After rendering out the separate sky images, the files were taken into Adobe Photoshop for minor changes and placed into a text editor and placed appropriately. They were then exported out as a VRML file and placed in the final scene. Figure 4.13 contains examples of the images used in the final skybox:
Figure 4.13: VRML Environment Skybox: Final Images

The following are images of the making of the individual models in the VRML Environment:

Figure 4.14: Screen Capture showing the land being modeled in Alias|Wavefront’s Maya 3D Software
Figure 4.15: Screen Capture showing the Courthouse model and texture layout in Maya
4.1.2 ROAD DEVELOPMENT ANIMATION

The final placement of 3D Road Development Animation image (Figure 4.16) demonstrates the final location for the 3D animation in the moving map. The animation is contained under the “Zane's Trace” link and is represented with a flashing “hotspot” that the user can select. This section of the timeline is represented by the color Red and will display the path and direction of Zane’s Trace. The animation “hotspot” will be Red and once selected, the animation will open in a new browser window for user convenience, similar to the VRML Environment.

Figure 4.16: Final Placement of 3D Road Development Animation
The following are final images of the models in the 3D animation:

![Figure 4.17: Final Deer Model, Scene 1](image)

![Figure 4.18: Final Horse Model, Scenes 2 & 3](image)
Figure 4.19: Final Conestoga Wagon Model, Scene 3

Figure 4.20: Final American Indian Model, Scene 2
Figure 4.21: Tree Generation Models for Landscape

Figure 4.22: Final Model-T Ford Model, Scene 4
The models and environment were built using Alias|Wavefront's Maya Software and Greenwork's XFrog Tree Generation Software (Figures 4.17 - 4.22). All of the models (except the trees) were built, textured, and rendered using Maya. The trees were generated using XFrog and imported into Maya and placed in the scenes.

The animation consists of three major scenes:

Figure 4.23: Scene 1, Deer Scene

The purpose of Scene 1 (Figure 4.23) is to introduce what the land and vegetation might have looked like for that specific area on Zane's Trace. It also introduces a deer grazing and a Native American Indian hunting the deer. The deer indicates the type of animal that is typical for
this area and the Indian represents Indians living on the land hunting the animals and creating Indian trails that are influential in the early roadway development.

Scene 2: Conestoga Wagon scene
The purpose of Scene 2 (Figure 4.24) is to show how the roads changed from narrow Indian trails to wider wagon trails. The vegetation changes during this period as trees were cut to make way for early roads. The scene also shows an early mode of transportation with the use of the Conestoga Wagon.

Figure 4.24: Scene 2, Conestoga Wagon and Horses
Scene 3: Model-T scene
The purpose of Scene 3 (Figure 4.25) is to show the evolution of wagon roads into wider, more modern roads. The scene also shows the Model-T Ford as another mode of transportation used in the early 1900's.

Figure 4.25: Scene 3, Model-T Ford
CHAPTER 5

DESIGN REFINEMENT

5.1 MOVING MAP INTERFACE

After defining the final layout and trial color scheme shown in Figure 5.1, the next step is to refine graphics and decide on a final color scheme for the moving map and interface. Because color is used to distinguish different sections of the timeline as they are overlaying each other on the map and at the same time create balance and harmony, it was difficult to determine on a proper color scheme. After reviewing effects of this trial color scheme seen in Figure 5.1, it was clear that the color served its purpose to separate sections and create visual cues but did not create balance and harmony on the page. This is because all of the colors are strong and equal in value. Also, too much color exists in the timeline and takes away from the design aesthetic. In order to achieve balance and harmony in the display, it was decided that limiting the strong colors to as little an area as possible would create a positive effect. In the Final Layout and Color Scheme image (Figure 5.2), the color is designated only in the thin strip above section titles. This allows the user to see the colors but at the same time doesn’t overwhelm them. The final colors that are in the display are a muted yellow, muted Orange, Red, bright green, royal blue, cyan, and a bright yellow. Although most of these hues are strong, because of the limited space they occupy, they do not compete with the map itself. The hues compliment the earthy-green background and stand out when animation is running.
Figure 5.1: Final Layout and Trial Color Scheme

Figure 5.2: Final Layout and Final Color Scheme

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The following are images of the different sections in the final Moving Map:

Figure 5.3: Final Layout, The Old Northwest Territory in the late 1700’s

The Old Northwest Territory is the first section of the map (Figure 5.3). It depicts the borders and region included in the territory. The territory is represented by a semi-transparent yellow, which corresponds to the yellow section in the timeline, and includes historical information about the territory upon roll-over with the user’s mouse. The user can also compare this region to the existing Midwest region border.
Ohio Trails is the second section of the map (Figure 5.4). This section shows the important Indian and Military trails that were influential in the making of Zane’s Trace, the first road in Ohio. The trails are represented by an orange color, which corresponds to the orange section in the timeline, and include historical information about the trails upon roll-over with the user’s mouse.
Zane's Trace is the third section of the map (Figure 5.5). The Trace was important because it was the first major thoroughfare in Ohio. The Trace is represented by the color red, which corresponds to the red section in the timeline, and includes historical information about the road upon roll-over with the user's mouse. The path of the Trace is overlaid on the Ohio Indian and Military Trails that influenced it. This section of the map also houses the link to view the 3D Road Development animation. This link is represented with a flashing "hotspot" that the user can select.
Early Towns is the fourth section of the map (Figure 5.6). These towns were the very first settlements in Ohio. This section is represented with green icons, which corresponds to the green section in the timeline, and includes historical information about the towns upon roll-over with the user’s mouse. This section of the map also houses the link to view the virtual environment of the Chillicothe Courthouse. This link is represented with a flashing “hotspot” that the user can select.
Figure 5.7: Final Layout, The Path of the National Road through Ohio, Indiana and Illinois

The National Road is the fifth section of the map (Figure 5.7). This section shows the path and general direction of the development of the National Road. The National Road is overlaid on the previous Zane’s Trace and Ohio Trails for comparison and reference. This section is represented by the color blue, which corresponds to the blue section in the timeline, and includes historical information about the road upon roll-over with the user’s mouse.
US Route 40 is the sixth section of the map (Figure 5.8). This section shows the path and general direction of the development of the Route through Ohio, Indiana and Illinois. Route 40 is also overlaid directly on top of previous roads for comparison. This section is represented by the color cyan, which corresponds to the cyan section in the timeline, and includes historical information about the road upon roll-over with the user’s mouse.
Figure 5.9: Final Layout, The Path of Interstate Highway 70 through Ohio, Indiana and Illinois

Interstate Highway 70 is the seventh section of the map (Figure 5.9). This section shows the path and general direction of the development of the Interstate through Ohio, Indiana and Illinois. Interstate 70 is overlaid on top of previous roads for comparison. This section is represented by a bright yellow color, which corresponds to the yellow section in the timeline, and includes historical information about the Interstate upon roll-over with the user's mouse.
CHAPTER 6

DESIGN EVALUATION

The evaluation in this project consists of summarizing the final design solutions, which are based on my understanding of the existing design problems. The evaluation also consists of summarizing the design criteria established to structure and develop project solutions.

This project involves developing visual displays that coincide with historical data to be used as a prototype that will be viewed on-line or on a CD-Rom. In these visual displays, the project involves developing methods of communicating data in a non-static, interactive form specifically with the use of animation. In order to develop these methods successfully, it is necessary to establish a set of design criteria that will guide the design process and produce successful results. The established design criteria were developed from research conducted on expert theory and existing visual displays. The design criteria used in developing project solutions are as follows:

1. **Hierarchies are vital in organizing information and are necessary in viewer direction and comprehension.**
2. **Animation serves as an effective tool for communication when overlapping multiple layers and time.**
3. **Cross-referencing is vital for the user to be able to digest multiple theories that influence each other.**
4. **Color-coding is necessary and especially helpful for moving parts.**
5. **An appropriate blend of simplistic and sophisticated graphics is necessary to help eliminate “information overload” and to simultaneously create a pleasing design aesthetic.**
6. **Limiting the amount of simultaneous moving parts may eliminate confusion for the user.**
In each phase of this project, these six design criteria acted as fundamental design “rules” that structured the design process and were an aid in developing successful solutions to the major design problems.

6.1 DESIGN PROBLEMS AND SOLUTIONS

1. How do I visually represent information changing over time in an interactive web interface?

From the research conducted, Design Criteria rule #2 was formulated, which is, *Animation serves as an effective tool for communication when overlapping multiple layers.* The ability to represent information changing over time in an interactive display or web interface involves overlapping two layers, data and time. Through the use of proper timing, animation grants a designer the ability to overlap layers of information easily and at the same time enables a designer to develop a more sophisticated design.

As in this case, when it is necessary to overlap multiple layers, the static quality of linear materials such as written documentation, images, or exhibits makes it difficult comprehend because of the complexity of all the factors. For example, in this project, the Moving Map depicts the paths of the first major roadways in Ohio and how they were developed over time. This would be difficult to show in one image because of the influential factors such as American Indian trails, topography, and the time element involved. With the use of two-dimensional animation, all of the pertinent information was layered and multiple frames were used to time the animation properly and produce more favorable results versus static mediums. The progression of the roads was laid out in a linear fashion and visually shows the transformation and influences of one road to another, which will aid in comprehension of the historical content. Because of the nature of existing 2D graphic software, many tools are at the designer’s fingertips. For example, some of the tools used were placement changes of graphics, transparency shifts, and changes in scale, all which aid in effectively overlapping multiple layers.
2. How do I effectively show 2 dimensions, data/spatial maps and time concurrently?

3. How do I develop a web interface that is logical and effective for the user? What components are necessary for me to achieve this?

It was the Design Research and Ideation Phases of the project that the second and third design problems were answered. From the research conducted, Design Criteria rules #1, 3, 4, 5 and 6 were formulated. These design rules are:

- **Hierarchies are vital in organizing information**
- **Cross-referencing is vital for the user to be able to digest multiple theories that influence each other**
- **Color-coding is necessary and especially helpful for moving parts**
- **Using simplistic graphics may help to eliminate “information overload” but may take away from the design aesthetic**
- **The use of multiple moving parts may be confusing for the user**

In order to effectively show two dimensions concurrently, cross-referencing is necessary. The reason that cross-referencing is vital is because, from the research conducted in this study, timelines in combination with other data or animations established relationships between the layers of the project no matter how the project was presented. What made these relationships logical and effective for the user was a clear hierarchy of information, the use of color-coding, using a combination of sophisticated and simple graphics, and eliminating confusion for the user by limiting the use of too many moving parts. These components were the basis of the prototype design solutions.

In each display created, a clear hierarchy of information exists. For instance, in the moving map, there is a linear path of information that is split up into sections. These sections are all color-coded to distinguish them from each other and also to create visual cues. A combination of sophisticated maps, models, and textures compliment the simple navigational cues such as in the Moving Map and in the 3D VRML environment. Each display also consists of moving parts but at the same time offers interactivity within the display. This interactivity allows the user to move at their own pace and helps to eliminate user confusion. All of these elements of the design aid in creating a logical and effective display.
4. How does my interface interact with Midwest Encyclopedia’s site?

The displays created in this project will be viewed on-line or on a CD-ROM. Because of the design of the displays, they are able to be integrated into the existing pages of the Midwest Encyclopedia’s site (http://www.allmidwest.org). The displays could be viewed under the Transportation: Roads, Routes and Trails section of the Encyclopedia. The displays can also act as a stand-alone section of the site that would offer on-line visuals and graphics for each section of the Encyclopedia.

5. How do I design for such a diverse user group?

After defining the scope of the project, a list of possible uses for the displays was developed. The displays might be used in: schools, colleges, libraries, museums, homes, businesses, government agencies, tourism departments, and convention bureaus. Considering this information, groups were established to define, in general, the people who might use these displays. They are:

a) Range of younger users (age 10) to older users (age 65)
b) In-experienced Web Users
c) Experienced Web Users

By formulating the design criteria for the project, these criteria would structure design solutions that would customize themselves to all three different groups of users. For example, the final designs contain many visuals that will engage users young to old. Because of the amount of visuals in the displays, it is also user-friendly for inexperienced web users that may not be used to links or “hotspots.” Engaging these inexperienced users with moving parts in a linear fashion, sophisticated graphics, and visual cues will aid the user in navigating through the interface. For the more experienced web user, there is a virtual environment. This environment consists of a more complex interface that might be confusing for inexperienced web user. However, with the addition of instructions in the display, the less experienced user is able to learn and navigate their way through the environment. These preliminary predictions need to be tested in the future User Testing phase of the project to either confirm or negate preliminary predictions.
6.2 PROJECT CONCLUSION

In conclusion, this project demonstrates how animation provides a designer the ability to convey multiple complex layers of information concurrently through the use of functional and visually engaging graphics versus static text and images. This project consists of a combination of visual graphics such as a web interface, linear 2D animation and 3D animation, an interactive timeline, and a virtual environment. These visual graphics are in the form of displays created based off of expert theory and established design criteria.

The graphics in this project are used to better explain early roadway development in the Midwest. These visual representations are the first in a series of interactive and linear works, used specifically by Midwest Alive, a group responsible for creating graphics for the on-line encyclopedia for the Midwest.

6.3 FINAL DELIVERABLES

The final deliverables for this project are three visual displays formatted on a CD-ROM attached with this thesis document. The three visual displays and a PDF of the thesis document are contained in an interface that includes system requirements and instructions.

6.3.1 CD-ROM DESCRIPTION AND SITE MAP

The CD-ROM for this project, titled "A Prototype for the Digital Midwest Alive," houses the Moving Map, the VRML Environment, the 3D Animation, and the thesis document created in this project. Upon loading the CD, instructions guide the user on system requirements needed to view the project (Figure 6.1).
Once the user has met all of the system requirements, the user may move onto an interface which includes links to the following displays:

- Moving Map
- VRML Environment
- 3D Animation (Currently represented by rendered stills)
- Project Information & Credits
- Existing Encyclopedia Website & Sections
- Thesis Document (PDF Version)
6.3.2 SYSTEM REQUIREMENTS

The system requirements for this project are:

- A Flash 6 Player (http://www.macromedia.com/downloads/)
- Cortona VRML Client 4.1
  (http://www.parallelgraphics.com/products/cortona/download/iexplore/)
- An Internet Browser (Internet Explorer 5 and higher or Netscape)
- Windows (98 or higher) or Mac Platform (OS 9 and higher)
- CD-ROM Drive

Depending on the speed of the user’s computer determines the load time of each display. On average, the load time for the displays should be less than one minute. If the user has a slow computer, the load time could be anywhere from 1-10 minutes for the VRML Environment.

6.4 NEXT STEPS

Three major “next steps” exist for this project. They are:

- User Testing
- Integration into Existing Site
- Project Changes

User Testing

The first “next step” for this project is to conduct user testing on the CD-ROM layout and the three visual displays created for this project. The user testing would focus on the communication of the content, usability of the displays, and aesthetics. The testing would be in the form of one or more focus groups that targeted different potential users such as high-school students, college students, museum and library users, web users, and people with disabilities. The testing would be conducted with little instruction and no interaction with the facilitator to test the user’s comprehension of the material and navigation through the CD-ROM. Once testing was
done, a refinement phase would take place to incorporate changes based on evaluations of focus groups.

Integration into Existing Site

The second “next step” for this project is to incorporate the three visual displays into the existing Midwest Encyclopedia’s site (http://www.allmidwest.org). The displays would be contained under the Transportation section of the website. Incorporating these displays would entail working with the existing Midwest Encyclopedia’s Web Administrator or Designer to determine integration of project and to solve any potential integration problems.

Project Changes

After finishing this project, there are many things that could be changed or done differently. One major change for this project is focusing it on creating one specific visual display rather than three. By reducing the size of the project, all efforts could be put into developing a detailed display that covered one topic rather than covering the broader topics chosen in this project. For example, rather than creating three separate displays that use different mediums, one medium with one topic would be chosen. This is desired because the content that was chosen covered over two hundred years of history. Because of this, more time was spent on researching the historical content when it should have been focused on the design of the displays.

Another major change for this project is allotting more time to complete the project. Because of the broad project content, it was difficult to finish all of the displays. Even if the project were smaller, starting it earlier and allowing more time to focus in on detailed areas is necessary. The following are the changes that could be made to make the project more successful.

VRML Environment- One problem area is that the VRML environment of the Chillicothe Courthouse is not optimized to be viewed on the web by a dial-up modem. The download time is exceeds ten minutes to download all of the textures for the environment from a dial-up 56k
modem. Also, building the environment up with trees and buildings as the settlement was in the mid 1800’s needs to be resolved.

**CD-ROM Interface** - Another area that needs more attention is the CD-ROM interface, which integrates the three displays. Because of time constraints, that area of the project did not receive as much attention as it could have if the project was smaller. If there were more time, alternate layouts and design solutions could be created to better integrate the three visual displays.

**User Instruction** - The CD-ROM includes basic instructions, however, additional user instruction and additional text on historical information could be provided along with the displays to aid the user in comprehension and navigation.

Although changes need to be made to make the project more successful, many aspects of the project work well. The following are the areas of the project that work well.

**Modular Design** - One aspect of the project that works well is the fact that the displays are modular. They can be updated, built on to, and changed at any time and integrated separately into other areas of the Encyclopedia if desired.

**Moving Map Design** - Another area that is successful is the Moving Map Interface. The graphics and interaction is effective. The representation of the progression of the roads is accurate and is how it was originally intended.

**VRML Environment** - The representation of the Chillicothe Courthouse is similar to reference images and visually appealing. This environment is interactive and engages the user into the scene.
6.5 PROJECT SIGNIFICANCE

This project is significant for the following reasons:

Established Design Criteria- During the course of this project, design criteria was established to structure the design solutions. These six design “rules” can be referenced and followed by others that are developing projects of a similar scope.

Contribution to Future Midwest Alive work- Future creators of visuals for *Midwest Alive* will have this project, positive and negative aspects, as a reference to learn from.

Substantial Thesis Document- This project included creating this thesis document that can be referenced in the Main Library at The Ohio State University for projects of a similar scope.

Addition to Interactive Design Study- This project contributes to the Department of Industrial, Interior, and Visual Communication Design’s area of study into *Interactive Design*. 
7.1 THE EVOLUTION OF EARLY ROADS IN OHIO – THE HISTORY OF ZANE’S TRACE

Around the year 1796, Colonel Ebenezer Zane was commissioned to establish the first road through Ohio. Zane was an explorer, who previously in 1769 founded Wheeling, West Virginia. Being the leader of the group that started the settlement, near the Ohio River, Zane was awarded the title to the property of Wheeling. Zane wanted to explore the Ohio country to enhance his property at Wheeling by developing a road that would go between Wheeling and Maysville, Kentucky (Schneider and Stebbins).

Zane and his group started in Wheeling and cut through the forest, following old Indian paths and trails cut by white armies when they could. Outside of Wheeling they followed the Mingo Trail, to the mouth of the Licking (which today is near Zanesville, Ohio). From there, some say that they followed a trail called the Moxahala Trail to Chillicothe (Figure 7.1), the only settlement on the route. From Chillicothe to the Ohio River, Zane followed a white army trail cut by Colonel Robert Todd in 1787 (Figure 7.1). His group crossed the river to Limestone (Maysville), Kentucky and completed the Trace in about one year. Many people soon used the Trace for travel between Kentucky and Pennsylvania (Schneider).
Figure 7.1: Approximate locations of Indian and Army trail

Figure 7.2: The early path of Zane's Trace (Schneider and Stebbins 5)
Ebenezer Zane was rewarded for his efforts with land deeds from Congress. He used his property to pay his helpers in cutting and opening the Trace. Around 1798 to 1800, Zane’s group soon operated ferries and settled the land around the Trace, developing towns called “Zanesville,” near the Muskingum River and “New Lancaster” (Lancaster), near the Hocking (Figure 7.3). Zane was virtually giving land deeds away to attract more settlers (Schneider and Stebbins 22).

![Map showing principal cities on Zane’s Trace.](image)

Figure 7.3: The settled towns along the Trace (Schneider and Stebbins 31)

7.2 THE EVOLUTION OF EARLY ROADS IN OHIO – THE HISTORY OF THE NATIONAL ROAD

In 1806, President Thomas Jefferson signed an act into law “to regulate the laying out and making a road from Cumberland, in the State of Maryland, to the State of Ohio” (Shank). Originally, the National Road was planned to run to the Mississippi River and as Ohio, Indiana, and Illinois joined the Union, the federal government made agreements with the states to build the road. Because of the War of 1812, the construction of the road progressed slowly and not until
1818 was the "Cumberland Road" officially opened from Baltimore to the Ohio River at Wheeling. Initially, the building of the road was not very well thought out and it was made of stone, gravel, and sand. By 1824, because it was so heavily traveled by Conestoga Wagons, stagecoaches, mail carriers, traders, freight wagons, farmers and settlers, the Cumberland Road was in terrible shape. Because of the needed repairs, then President Monroe signed a bill that provided funds for the old road to be rebuilt. This time uniform stone, around 30 feet wide, was laid (Schneider).

Because of the political conflicts between the states and federal government, the building of the road west of Wheeling was a slow process. By 1833, the road was completed to Zanesville, Ohio and then to Springfield, Ohio in 1838 (Figure 7.4). The next leg of the road started in Indianapolis, Indiana and was built in both east and west directions to connect it with the Springfield extension to the east and taking it into Illinois to the west. By 1850, the road reached Vandalia, Illinois when construction was stopped because of federal funding issues (Figure 7.4). After the portions of the road were built, the states gained control over the road from the federal government. They immediately set up tolls to create revenue for the road’s maintenance but for years little was done to keep the road in adequate shape (Schneider).

The National Road proved to be an important artery to the west for several reasons. First, Ohio and Indiana began receiving more than ninety thousand inhabitants a year and at least ninety per cent of them came by way of the National Road. It also made it possible for commercial and political ties to be maintained in the United States as a whole. However, within ten years of the road’s completion, it was becoming obsolete for cross-country travel to the Mississippi River because of the development of the railroads. It wasn’t until around 1880 that travel again started to pick up because of the invention of the bicycle. By the early 1900’s the automobile was invented and states were forced to improve their roads (Schneider).
7.3 TOPOGRAPHY OF OHIO – HISTORY OF ZANE’S TRACE

Early on, the Trace was narrow, only wide enough for mail carriers on horseback. Trees such as great oak, beech, elm, maple and sycamore shaded the Trace. This was because Zane and his group only cut down enough to get through. They did not prepare the trace for wagon travel. It wasn’t until around 1804 that the Trace was added onto in areas to provide a wider road for travel. In 1805, the Trace was said to be “the new state road” (Schneider and Stebbins).

The land where Zane’s Trace was cut was hilly country (Figure 7.5 and 7.6) and the route was steep and full of ruts. The Trace was slow travel and often trying for travelers. The wagons had trouble going down the steep hills and the ruts made for hard and jolting impacts (Schneider and Stebbins).

Today, some of the Trace still exists and I had the opportunity to visit an area of it outside of Zanesville, Ohio (Figure 7.5 and 7.6). People of that area say that the Trace looks just as it did two hundred years ago, minus the trees and vegetation. I observed that the Trace was
high on a ridge and was often full of hills and curves. The Trace, still today, is fairly narrow. It is only approximately seventeen feet wide. Below are images of present day Zane’s Trace:

Figure 7.5: Many parts of the Trace are on a ridge
Figure 7.6: Images showing Typical Vegetation, Hilly Terrain, Narrow-Path, Curves, and Ridge
In 1796, settlers including Nathaniel Massie founded Chillicothe, the first settlement on Zane’s Trace. In 1800, the territory (surrounding what is now Ohio) was on its way to statehood and was split. In 1803, Ohio was formed and Chillicothe served as the first capital of the state (www.firstcapitalohio.com).

The Chillicothe Courthouse played a large part in Ohio history (Figures 7.7 and 7.8). It was here that Ohio’s constitution was signed in 1802 and used by the territorial legislature during the early 1800’s. The Courthouse contained one center structure with smaller surrounding structures. The Courthouse was dismantled in 1852 (www.firstcapitalohio.com).

Figure 7.7: Chillicothe Courthouse and surrounding structures (sketch by Jack Bennett)

Figure 7.8: Chillicothe Courthouse (Ohio Historical Society Picture Collection)
Route 40 was certified to be built in 1926 and from Baltimore, Maryland to Vandalia, Illinois followed the already existing National Road. “Over the years, Route 40 and the National Road have become synonymous” (Brusca).

Interstate Highway 70 was certified to be built in 1962 and today, also, parallels the National Road. Both US Route 40 and Interstate 70 paths were influenced by and mimic the National Road and the early Zane’s Trace. Without these early influences, the paths of these modern roads might have been quite different. Below are the paths of Route 40 and Interstate 70 from Wheeling, West Virginia to Vandalia, Illinois (Figures 7.9, 7.10, 7.11).

Figure 7.9: Layout of Route 40 and I-70 through West Virginia and Ohio (Raitz)
Figure 7.10: Layout of Route 40 and I-70 through Ohio and Indiana (Raitz)
Figure 7.11: Layout of Route 40 and I-70 through Indiana and Illinois (Raitz)
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