

**Interface Design for Spatial Data Visualization:
A Web-Based Integrated Multimedia Approach for the Tren Urbano Project**

By

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Introduction

In order to enhance the understanding of the spatial complexity of a transportation planning project, one needs to present the information from multiple viewpoints using a variety of different flexible representation aids such as sound, motion, still images, maps, and animation (Langerdorf, 1992, p.723). Visualization of information can greatly assist in the conceptualization of a particular planning situation by graphically representing multiple layers of information and displaying technology as an interface between user and data. Today's technology systems need to provide knowledge to users as well as data and information and ways to better understand and explore the project site through its geography.

Multimedia comprises of a variety of digital data forms such as text, graphics, still image, maps, photos, diagrams, sounds, motion, animation, video, 3D models, etc. that provides the user with a high sense of interaction and control. In the past few years increasingly, multimedia has been receiving great attention through its use in the World Wide Web. The sensory overload people are experiencing in recent years brought visualization of information to the forefront of discussions. The use of the Internet allows the incorporation of a range these visual forms and offers a flexible, platform independent, dynamic environment that seems very suitable for developing and delivering integrated multimedia solutions. A web-based approach can facilitate the effectiveness of communication, understanding, decision-making ability and analysis of a problem among participants of the planning process.

In my thesis, I propose to develop and evaluate a technological framework that draws on the advantages and unique characteristics of an integrated multimedia approach. Furthermore, this project aims to demonstrate how the Internet, through visual representational aids, can be used as a medium for communicating, visualizing and understanding transportation planning in the Tren Urbano context. The multimedia capabilities of the Internet will be able to translate complex spatial concepts in an easily understandable format.

Objective

Urban planning professionals can take great advantage of the new advances in computer visualization technologies as geographic visualization is becoming an increasingly affective tool that encourages the creation and inspection of multiple views of data sets, allowing the users to understand the project from a spatial and temporal context. Large amount of imagery has been generated for the Tren Urbano project that reside at different location, yet a system hasn't been developed to take advantage of the enhanced value data integration can offer. The primary aim of my thesis is to develop a web-based integrated multimedia approach in order to deliver geographic information by integrating various types of data sets into a multimedia product. This approach will allow users to experience the Tren Urbano project site as a virtual space and explore spatial information through different medium. This online visual resource center will include information about the Tren Urbano alignment and its surrounding area. The physical context will be explained partially through text, but mainly through spatially organized multimedia elements such as maps, aerial photos, GIS information, panorama pictures, CAD drawings, photos, and 3D-models.

The proposed system would provide a significant hypermedia collection of materials through the Internet that can be useful to academics, students, professionals and the general public affiliated with the Tren Urbano Project. I will develop, test, and initially evaluate a networked architecture that not only incorporates the above mentioned elements, but also has the capacity to describe the current and proposed physical characteristics of the Tren Urbano alignment. In addition to the multimedia, the resource center will integrate past and present student research projects to provide an effective Tren Urbano information clearinghouse. Part of this objective is the value-added possibility that the proposed online resource center will allow interactivity through dynamic contribution (uploading) by its users which will enable future expansion of the site.

By offering enhanced visualization of geographic data through an integrated multimedia approach, an additional objective of the thesis will be to facilitate exploration, analysis, presentation

and communication among different participants in the transportation context. Upon completing the prototype, I will evaluate how the participants of the Tren Urbano project will interact with the spatial information presented. I wish to design an interface between user and project site such that would allow the user to have a meaningful interaction that is high in educational values. I believe that a multimedia approach will prove to be a platform for interactive exploration, inquiry and creative application.

Hypothesis

"Visualization is a method of computing. It transforms the symbolic into the geometric, enabling researchers to observe their simulations and computations. Visualization offers a method for seeing the unseen. It enriches the process of scientific discovery and fosters profound and unexpected insights. In many fields it is already revolutionizing the way scientists do science" (McCormick et al, 1987, p.2)

According to Langendorf, "computer graphics can aid creating alternatives, and facilitate communication with others. They may also facilitate group participation in analysis and planning and contribute to conflict resolution and decision-making"(p.737).

Visualization of information can not only facilitate greater understanding of the planning process by providing information in an easily understandable format, but also aids in the organizing, analyzing, and communicating large amount of complex spatial and non-spatial data. Furthermore, it can be argued that visualization of also facilitate group participation, and conflict resolution.

In order to achieve this result, we need to integrate visualization tools such as multimedia into a comprehensive online-resource system that can access and filter a large amount of information from a variety of sources (Shiffer, 1992).

A multimedia approach to illustrating an urban construction project would be able to better present spatial relationships by using the visual methods of representation as opposed to only textual information. The technology will allow linking descriptive images in order to communicate the physical infrastructure of the Tren Urbano alignment visually. For example, users can experience the construction site much better by "flying over" it, driving through it, or navigate over 3D maps.

The power of such multimedia solution is that the user can quickly browse the project site and easily "dig" deeper for further information until the desired data is found. Using their mouse, users can

select what they want, when they want it, without the constraint of searching through unwanted material in the usual linear fashion.

Research Questions and Issues

I wish to analyze and understand how collaborative planning systems and computer visualization technologies can be integrated into a transportation planning context in order to facilitate greater understanding of the process.

On a theoretical level, the main research question I wish to explore is: how can one facilitate technology transfer in an urban transit context using Information Technology as a catalyst among professionals, academics, government officials and the public?

Supplementary questions I wish to explore include:

1. How can computer visualization tools be applied to an urban transit environment?
2. How can this multimedia approach be used in other context?
3. How can this online multimedia infrastructure be improved and changed over time?
4. What is the necessary technology infrastructure needed to allow for an effective way to address scalability issues?
5. How should spatial and non-spatial data be organized to suit the needs and objectives of the different Tren Urbano participants?
6. How should one develop multimedia presentational methods that effectively depict and communicate information about the given geographic location?
7. What is the suitability of animation and other visual aids to effectively communicate the spatial and temporal changes in the Tren Urbano project?
8. What are the most effective methods to be for interface design and interaction between the site and the user?
9. What is the best way to document user contributions online?
10. How can one link many representational forms together in a hypermedia context?

Deliverables

The project will be delivered and implemented through the Internet since it offers an infrastructure that is platform independent, and provides a cheap and effective way to provide access to information to a global audience. It also offers a dynamic and interactive environment that seems to

be very well suited for a multimedia delivery method. Up to date, the Internet is the only medium capable of complex visual and spatial information delivery to a wide audience regardless of their geographic location.

The framework of the development of the prototype will follow Shiffer's technique as used in the development of the collaborated planning systems technologies (Shiffer, 1995).

1. Identification of user needs.
2. Creation of a multimedia information system using major metaphors such as maps, images, documents, tools.
3. Evaluation and presentation of the system through user feedback.

1. Identification of user needs.

In order to determine the success of the project, I must identify objectives and needs of the Tren Urbano participants. I will need to identify the questions users will try to answer by using the visualization tools I intend to develop. Not only the specific audience must be carefully identified, but the purpose of the site must be identified in order to have the most effective design approach. Who is the project intended to serve? What information will be presented and in what manner? How much interaction is necessary between the user and the site?

2. Creation of a multimedia information system using major metaphors such as maps, images, documents, tools.

The actual site content will be organized from a geographic point of view that will allow the user to explore the physical characteristics of the Tren Urbano project by clicking on different locations on the map. The broad range of visualization forms represented by multimedia delivery methods can serve as a solution to extent beyond the limitation of presenting information through text. By presenting information through multimedia, the user appears to be in total control of the exploration of information. However, the creator of the project would impose real control as to what extent and in what sequence the user can explore the information.

The users will be able to search through information spatially by clicking on maps, or visually, by searching through multimedia elements such as photographs, models, videos, etc. or searching through text.

One of the approaches for delivery of information is through layers of maps that contain hotspots and links to additional textual and visual information thus allowing users to experience the project site spatially. The user can be offered visual navigation that would provide a plan of the possible paths through the spatial data presented.

Tools offered in the site will allow users to explore spatial patterns of the Tren Urbano alignment. Identify the relations between spatial and temporal patterns through fly over videos and still images or through dynamically linked views.

3. Evaluation and presentation of the system through user feedback.

Surveys and interviews will be conducted to determine the degree of increased communication and understanding of the project among the participants. Performance and usage will be measured through the number of hits the site will receive, and number and quality of responses in comment blocks.

Through interviews and surveys I will try to estimate the extent to which users will be taking advantage of the project's non-linear way of presenting information and its visualization features. Evaluation of the site will consist of several methods such as fulfillment of the set of goals, proper documentation of the site, and usability interviews during the process of development in order to receive feedback regarding its functionality.

Expected Result

One of the major components of this thesis will be a finished web-based prototype that will act as a proof-of-concept for a multimedia system to support knowledge exchange for the Tren Urbano project. In addition to that, I wish to better understand how communication and understanding among users can be enhanced with the use of computer visualization tools and integration of different multimedia elements. I also wish to better understand what interface design principles must be applied to achieve the above-mentioned goal.