GIS Visualization: A Library's Pursuit Towards Creative and Innovative Research

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Abstract

As emerging technologies expand research potential, academic libraries are embracing technology by integrating it into almost everything they do. One such emerging technology is GIS, allowing for the visualization, analysis and interpretation of data in order to geospatially visualize and understand relationships, patterns and trends in data. Academic libraries are stepping up and embracing GIS by offering services, specialized expertise and technological resources to enable students, faculty and researchers the opportunity to incorporate GIS into their projects and research. Through the integration of such technology, GIS demonstrates its ability to assist in geospatially sharing data and resources, help individuals achieve their project goals and expand academic library research to a new level.

Introduction

Presenting an in-depth examination into GIS and the role it plays as an emerging technology in academic libraries across the country, this paper reviews how this technology is presented as a project-oriented service to students and researchers, the layers and levels that comprise the creation of a geospatial project and the overall impacts GIS has within higher education institutions.

Evolving Academic Libraries and Emerging Technologies

In the earliest days of libraries, institutions were designed for the primary purpose of preservation. Restricted access was a common practice and in general, the materials available were not for use outside of select individuals. This practice had to do with the production of materials, limited printing numbers and the fact that many materials were one of a kind. As we fast forward to modern and academic libraries, we see just how much these institutions have evolved. Over the past decade, academic libraries have evolved from quiet repositories for books and materials to active communities composed of technology, online resources and physical materials. Establishing a practice of openness among students and researchers, the academic library had developed a new mission within higher education institutions to both:

- Support the school's curriculum, and
- Support the research of the University students and faculty

The evolution of academic libraries has also developed a hidden identity that the public is becoming aware of by interpreting these institutions as established places for learning to take place. Academic libraries have transformed from offering books and materials to providing teaching spaces and technology equipment to aid in the pursuit of research. Providing the driving force of the academic library are specialist in diverse fields, available to assist and collaborate in a research environment designed for student and faculty success through open access to print, digital and technological options for pursuing research opportunities.

Research methodologies utilized to analyze, interpret and present information have continued to grow, leading to new and expanded service offerings for project and research assistance that simultaneously redefine the

image of the academic library and what it is capable of offering. Information in books and journals are now available on demand through online journals and databases. Digital repositories have been created to preserve and make available original works of scholarship while library publication opportunities are becoming openly available to students and faculty. Special collections and rare items are now presented by academic libraries while partnerships with specialized programs including Book Arts and University Press' open new opportunities for project collaboration and research development. These developments have also lead to changes in the role an academic library plays within higher education.

As emerging technologies expand upon current research potential, academic libraries are embracing technology by integrating it into almost everything they do. Recent trends include: the formation of audio and video production studios to allow researchers the opportunity for presenting sound and video components while taking the presentation of materials in a new direction, 3D printing machines and software for bringing research and concepts off of the drawing board to allow for physical interaction with ideas and prototypes in development, and finally, an emerging technology that is focused in this paper and becoming more prominent in academic libraries and institutions is the availability of GIS services and technology for geospatially visualizing data in new and exciting ways.

Defining and Understanding GIS

GIS is an acronym which stands for "Geographic Information Systems" or in recent trends being referred to as "Geospatial Information Systems" that represent a number of different geospatial technologies, software, processes and methods for visualizing different types of data within a geospatial visualization. In general, this type of data and information is presented through cartographic maps, interactive mapping platforms or geospatial infographics. At its core, GIS allows for the visualization, analysis and interpretation of data in order to geospatially understand relationships, patterns and trends in data. This process is accomplished through the incorporation of multiple layers, which when brought together creates a geospatial visualization that expresses and enhances data through the incorporation of visual resources. Layers that are utilized through GIS include: imagery (satellite or aerial photographs), elevation datasets (contour lines or elevation models), transportation datasets (street networks or railways), address information (geocoding and plotting locations), additional physical features (boundaries, hydrology or survey control points) as well as the research data collected that a researcher wishes to convey to viewers (Figure 1).

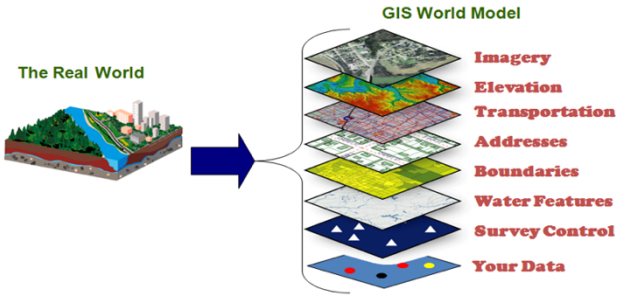

Figure 1 – GIS model image breaking down various layers which combine to represent features found in the real world. Source: Grind GIS

Through an educational and research focus, GIS plays an important role in the research and projects of students, faculty and researchers in several ways. First, GIS creates an improved communication of information. Statistical charts, spreadsheets and raw data comprehensible by individuals in select fields can be visualized and presented in a geospatial format that allows others outside of these fields the opportunity to easily interpret and draw conclusions from. Second, GIS-based maps and visualizations greatly assist in understanding situations and in the storytelling process. Many projects and research topics fall under this definition, allowing viewers the ability to visualize events and information at the heart of projects to relay thoughts, ideas and interpretations in ways text cannot. Third, GIS establishes a universal language utilizable between different departments, disciplines, professional fields, organizations and the public. It has been said that a picture paints a thousand words - in the case of GIS, a picture is painted geospatially representing discipline-specific data and information on demand that others can quickly access, understand and interpret. Finally, GIS allows for the visualization and display of many types of

data and can be used as a comparative tool for discovering how information relates. For these reasons, there are very few kinds of information and datasets that cannot be analyzed and displayed geospatially using GIS, making it an excellent resource for presenting and visualizing information in creative and innovative ways.

Enhancing and Expanding Data Through GIS

Through the conversion of raw data and print information into a geospatial visualization, GIS enables users the ability to share information quickly and visually while simultaneously determining many factors about the data. Information that can easily be discerned through a geospatial visualization includes:

- Gaining a clear understanding and indication of the extent in which the data and information represents through established and visualized map boundaries
- Understanding the focus related to the data and information by examining the level of detail at which information is presented
- Understanding what the data and information in each visualization represents through the review of a descriptive title and narrative, and
- Visualizing statistics through visual and thematic color schemes for the interpretation of information at a glance

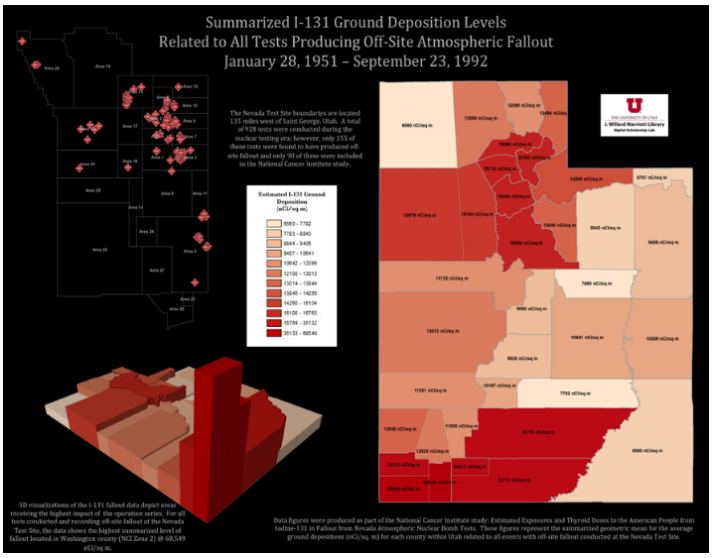

Figure 2 – Summarized Iodine-131 Ground Deposition Levels map demonstrating how raw data can be geospatially visualized for easy analysis and interpretation. Source: Downwinders of Utah Archive

By comparing raw data in its original form to that presented through a geospatial visualization, a clear indication of how GIS enhances and expands upon the information through its presentation and delivery can easily be visualized (Figure 2).

Moving beyond cartographic maps and visualizations, GIS opens the door to interactive data and learning concepts utilizing raw data through research and query functionality. Interactive visual charts are an excellent example of offering new perspective to raw data by extracting and visualizing incorporated information from standard spreadsheets (Figure 3). Functionality such as this offers the unique opportunity to interactively compare, analyze and interpret datasets in new visual and dynamic ways through the on demand generation of geospatial visualizations. To educate viewers and researchers of methods, events and processes contained and described within datasets, GIS in conjunction with 3 dimensional software allows for the creation of reconstruction animations and models for describing, visualizing and breaking down events as they progress (Figure 4). Being both educational

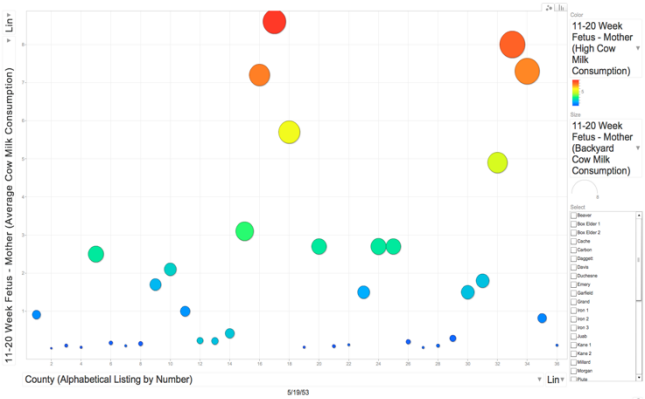

Figure 3 – Example of an interactive motion chart demonstrating how raw data can be visualized and interacted with through the on-demand generation of geospatial visualizations. Source: Downwinders of Utah Archive

and engaging, such materials offer the unique opportunity to visualize events as seen through an observer's point of view, further expanding upon text and data by allowing viewers to learn about events through an engaging learning experience. GIS also has the ability to bring new light to historical resources by transforming 2 dimensional maps and information into 3 dimensional perspectives (Figure 5). By scanning and digitally aligning historic maps on a digital model through a process known as georeferencing, a new method for viewing, interacting with and analyzing valuable collections, historical materials and resources becomes openly available to researchers of multiple disciplines and simultaneously establishes a new realm for academic library research.

Figure 4 – Example of city data reconstructed through a 3 dimensional interface for understanding changes in urban development.
Source: The Historical GIS of Salt Lake City

Figure 5 – Example of historic Sanborn Fire Insurance Maps georeferenced and displayed 3 dimensionally for viewing, interacting with and analyzing.
Source: Reconstructing the Past Through Utah Sanborn Fire Insurance Maps

Presentation of research materials, datasets and information through a geospatial platform creates an engaging and educational experience that is absent in text. Through the generation of interactive projects and interfaces, new opportunities for sharing and expressing information are presented by expanding research and learning objectives through easy to operate and accessible components and interactive materials. These projects and interfaces are based on a number of visual platforms including: interactive timelines with map and information analysis functions available on demand, 3 dimensional interfaces with historical datasets, components and visualizations that can be expanded upon and utilized in current or future research opportunities, or even a simple collection of maps geospatially presenting information are some of the many ways GIS can be utilized to assist in presenting and expanding upon information to others.

What an Academic Library Offers Through GIS

Academic libraries are stepping up and embracing GIS by offering services, specialized expertise and technological resources to enable students, faculty and researchers of higher education institutions the opportunity to incorporate GIS into their projects and research. Following upon the academic library's mission, services to educate and assist in research are becoming openly available including:

- Collaborative support in the creation and production of interactive and cartographic mapping projects
- Researching and procedures for locating, retrieving and creating geospatial data
- Support in developing skills for utilizing geospatial software programs
- Training support through workshops, online tutorials and resource materials, as well as
- Project collaboration assistance through one-on-one consultations

Accompanying such services are the overall impacts GIS has throughout an academic library. These impacts include:

- The development of digital collections to closely interact with and examine materials in ways previously unavailable
- The examination of multiple datasets of various formats within a single program, and
- The ability to convey print and multimedia materials through easily understandable visualizations and interactive platforms

Final Thoughts on GIS

GIS is a very beneficial tool for sharing data and resources geospatially while taking projects and research to a new level. The diversity of projects and disciplines utilizing GIS demonstrates a wide variety of possibilities for future research, project development and collaborations that students, faculty and researchers are able to openly utilize and access within their research endeavors. As our world continues to convert into a digital realm, GIS will continue to be one of the many tools academic libraries will have available to assist in geospatially sharing data and resources with others and in helping individuals to reach their project goals.

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Images Sources

- Figure 1 - GIS Model Image. (2015, January). "What is GIS – Definition?" Retrieved March 3, 2016 from http://grindgis.com/what-is-gis/what-is-gis-definition

- Figure 2 - Summarized Iodine-131 Ground Deposition Levels Map. (2016, March). "Downwinders of Utah Archive". Retrieved March 3, 2016 from http://www.downwindersofutah.org

- Figure 3 – Example of an Interactive Motion Chart. (2016, March). "Downwinders of Utah Archive". Retrieved March 3, 2016 from http://www.downwindersofutah.org

- Figure 4 – Example of 3 Dimensional Reconstruction Animations and Models. (2015, July). "The Historical GIS of Salt Lake City". Retrieved March 3, 2016 from http://campusguides.lib.utah.edu/thehistoricalgisofsaltlakecity

- Figure 5 – Example of Georeferenced Utah Sanborn Fire Insurance Maps. (2015, March). "Reconstructing the Past Through Utah Sanborn Fire Insurance Maps". Retrieved March 3, 2016 from http://campusguides.lib.utah.edu/utahsanbornfireinsurancemaps

About the Author

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