**The G-EX Portal: Web-Based Dissemination of Geovisual Analytic Results**

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## Abstract

Here we present work in progress on the G-EX Portal, a web repository designed to facilitate investigator-to-investigator research dissemination on the application of geographic exploration and analysis tools in cancer control and surveillance. The G-EX Portal is intended to serve four major tasks: to provide access to interactive tutorials for new geovisual tools and analytical methods, to search for multimedia research content, to enable basic different-place, different-time collaboration with geovisual multimedia, and to support peer review of geovisual analytic work. This paper presents our initial design and implementation work for the G-EX portal. Our design and development effort features two major parallel streams. First, we are designing interactive web interfaces for the four major G-EX tasks. Second, we are implementing extensions to existing geovisual analytic tools in order to allow users to easily export annotated images and multimedia clips, project descriptions, datasets, and analysis artifacts into the G-EX portal.

## Introduction

A critical need for the successful application of geovisual analytic tools is support for collaboration and decision-making using results gathered from exploration and analysis. Currently, users are not able to easily share their work in an environment that encourages cross-pollination of ideas and techniques. We report here on our efforts to design and implement a web-based dissemination environment called the G-EX Portal. Our clients are health analysts and policymakers at the National Cancer Institute (NCI) who have historically relied on paper publications and conferences as the major mechanisms for disseminating results. The G-EX Portal is designed to support dissemination and collaboration with results found using geovisual analytic tools in a web-based setting where materials can be stored, discussed, annotated, and searched for in an asynchronous, distributed manner.

The G-EX Portal effort includes two streams of parallel design and development. First, we are designing G-EX web interfaces. Second, we are implementing the means to export annotated images and video clips, project descriptions, datasets, and analysis artifacts from our geovisual analytic tools: ESTAT (Robinson et al. 2005), the Visual Inquiry Toolkit (Chen et al. 2006), the GeoViz Toolkit (Hardisty 2005), and GeoVISTA *Studio* (Takatsuka and Gahegan 2002).

## Background

Dissemination research in public health commonly focuses on the transfer of actionable knowledge from researchers to vulnerable populations (King et al. 1998). Prior work has focused attention on dissemination mechanisms to reduce tobacco use (Szpunar et al. 2006), to encourage people to reduce manipulable cancer risk factors (Marcus et al. 2005), and to promote heart health (Robinson et al. 2004). We are particularly interested to implement web tools to facilitate investigator-to-investigator dissemination in support of cancer research. Interactive mapping and spatial analysis tools should positively augment dissemination of actionable information to appropriate populations – but these tools are underutilized in the cancer research community. Reasons for this include lack of access to tool training, a lack of good examples (in journal publications or in other sources) demonstrating the successful use of geovisual analytics, and clumsy (or non-existent) mechanisms for collaborating with and about geovisual analytics.

At the root of the topic of dissemination in health research is the concept of diffusion of innovation. This theory holds that the transfer of technology occurs by way of key individuals (early adopters) who embrace new techniques and spread them among their colleagues (Rogers 1962). This idea was then augmented with a less passive theory of dissemination, which describes this process as an active effort to send technology "down the line" rather than the more organic way described by diffusion of innovation (Robinson et al. 2004). Dissemination has also been described as a two-way process, where both decision-makers as well as end-users participate in pushing knowledge back and forth (King et al. 1998).

The two-way process of dissemination shapes our approach to the design and implementation of the G-EX Portal. Our work is inspired in part by the collaborative media sharing sites YouTube (http://www.youtube.com/ ) and Flickr (http://www.flickr.com/), scientific literature sharing sites like Cite-U-Like (http://www.citeulike.org/) and scientific knowledge sharing sites such as GEON (http://www.geongrid.org/). These web portals and others like them provide easy access to a wide range of content in a format that encourages exploration, the development of topic-centered user communities, and basic collaboration through threaded discussions and item ratings. Users upload materials with the intention to share their media and with the assumption that other users will provide feedback and respond with their own submissions – a web-based implementation of two-way dissemination.

We call the individual materials collected in the G-EX Portal *analysis artifacts*. These materials include analytical results, datasets, reports, and other bits of information that are derived from interactive geovisual analysis.

## Scenarios of Use

The G-EX Portal will support four major dissemination-oriented tasks for cancer surveillance and control users of geovisual analytics tools. The following user scenarios describe these tasks in light of their real-world context.

**Learn**

Gary is a recent hire on an environmental exposure project at a medical school. His epidemiology training included a few introductory courses on using GIS with health data, but he has no experience with tools designed to explore multiple variables across space and time. Gary logs into the G-EX portal, selects the Learn module, and searches for tutorials that include the keywords “explore,” “temporal,” and “multivariate.” Several tutorials match those keywords, and Gary is able to select a series of lessons on using ESTAT, an exploratory geovisualization toolkit. The Learn module provides direct links to the materials necessary for the tutorial (ESTAT program files, tutorial data, and written copies of the instructions).

**Search**

Sam is director of a government biostatistics research center. Part of Sam’s job involves finding collaborators for future research projects. To do this, Sam reads relevant journal articles, attends conferences, and networks whenever possible. After reading a new call for proposals for chewing tobacco research, Sam uses the G-EX Portal to search for all references to tobacco in the artifacts located there. Sam finds video clips of analyses, relevant papers, datasets, and discussions – all with links to contact information for the people who created them. Sam finds a few pieces of research that are particularly compelling and determines this work is led by a team at the University of Nebraska, causing him to initiate contact with researchers there.

**Collaborate**

Alexis works as a cancer control expert a major government research headquarters in Washington, DC. John works at a private research firm in Indiana that develops geovisualization tools to support epidemiology. Together they have begun work on a small, exploratory grant to identify possible cancer clusters in Appalachia. Alexis and John use the G-EX Collaborate module to coordinate iterations of their work together. John is able to upload videos from his tools with what he thinks are interesting new patterns, and Alexis can respond to what he has found with her own analysis of the same information. She can provide annotated video clips that describe her perspective of the problem, and she can use the discussion interface to make new feature requests for the software that John is developing. To facilitate work, XML project descriptions are passed back and forth to make sure that users at both ends can recreate what they are seeing in the G-EX media viewer. G-EX allows Alexis and John to create new iterations as well as preserve older work. A visual “track” showing project progress appears on the G-EX Collaborate screen.

On a different project that focuses on racial disparities in prostate cancer mortality, Alexis collaborates with a new hire in her agency named James who works on the west coast. For this project, Alexis is using the G-EX portal in the role of a tool expert, and she uses the Collaborate module to help James get up to speed with the geovisual analytics tools that he will need to use for his new job.

**Review**

Julie is a research scientist at a state cancer registry focused on studying clusters of childhood Leukemia. Recently, Julie has completed a pilot study using several geovisual analytics tools that couple spatial statistics with exploratory visual methods. She has written a paper, but she would like to submit it with accompanying video clips showing some of the discoveries she made using geovisual tools. The G-EX Portal reviewing module lets Julie upload her paper for consideration to a journal that accepts submissions via G-EX. Julie's submission is then reviewed using an open-review process – a process pioneered by journals in physics, math, and geosciences (http://www.copernicus.org/EGU/publication/open_access.html). Reviewers can assign numeric scores to major aspects of the submission and provide written comments in a dialog box. Review scores can be represented with bar graphs and other users can browse reviews visually. Once Julie's submission has been accepted, the paper and its reviews are provided in the G-EX Portal via the Search module.

## G-EX Portal Design

We have recently completed initial interface designs for the main task modules of the G-EX Portal. The G-EX Portal entry page (Figure 1) establishes color, style, and icon guidelines that are kept consistent throughout the rest of the site.


**Figure 1: The G-EX Portal entry page design**

Based on the primary user tasks we must support, the G-EX Portal is split into four task modules. Users can choose to search for information, review submitted items, collaborate with others, or learn about new tools and analysis techniques.

## G-EX Learn

The G-EX Learn module is intended to open up new analytical tools and methods to a wider analyst audience. Currently, means to distribute and disseminate new geovisual analytic tools to potential end-users are ad-hoc and often not very effective. The G-EX Learn module is designed to house tutorial videos and other materials for training purposes. The module is designed for tool developers to contribute basic how-to videos for new analytical tools. Initially, we will seed the module with a set of tutorials for tools developed on our current NCI-supported research as well as on other complementary research projects. We also anticipate that typical end-users will eventually use the Learn module to upload instructional materials that describe analytical approaches they have developed.

Users can follow written instructions that accompany tutorial videos in the G-EX Learn module. Additionally, discussion areas are provided for users to ask questions about the materials or to discuss other topics. Forums like these are often used by software firms to ease technical support needs as expert users can provide advice for novices. Finally, users can directly download the tools, datasets, and tutorials for offline use.

## G-EX Search

The G-EX Search module (Figure 2) provides access to artifacts originating from geovisual analytic tools as well as relevant documents and datasets. The search module allows users to search for content by keyword and retrieve related items. A threaded discussion window provides a forum for each item – a place where users can ask questions to the content author, or engage in informal collaborative discussion with other users.

Metadata for each item is displayed to the right of the primary media viewer. Where possible, links exist for usernames, keywords, dates, and other descriptors. These links will allow users to branch off from an interesting item into other related areas in a variety of ways.

The Search module allows users to create items inside higher-level containers called projects. Projects are designed to mirror the work structures that exist at NCI (and many other research organizations), where analysts conduct work under the guise of various funded projects and initiatives. The G-EX Portal will adapt this type of structure into its interface so that users can store and retrieve items from a familiar framework.

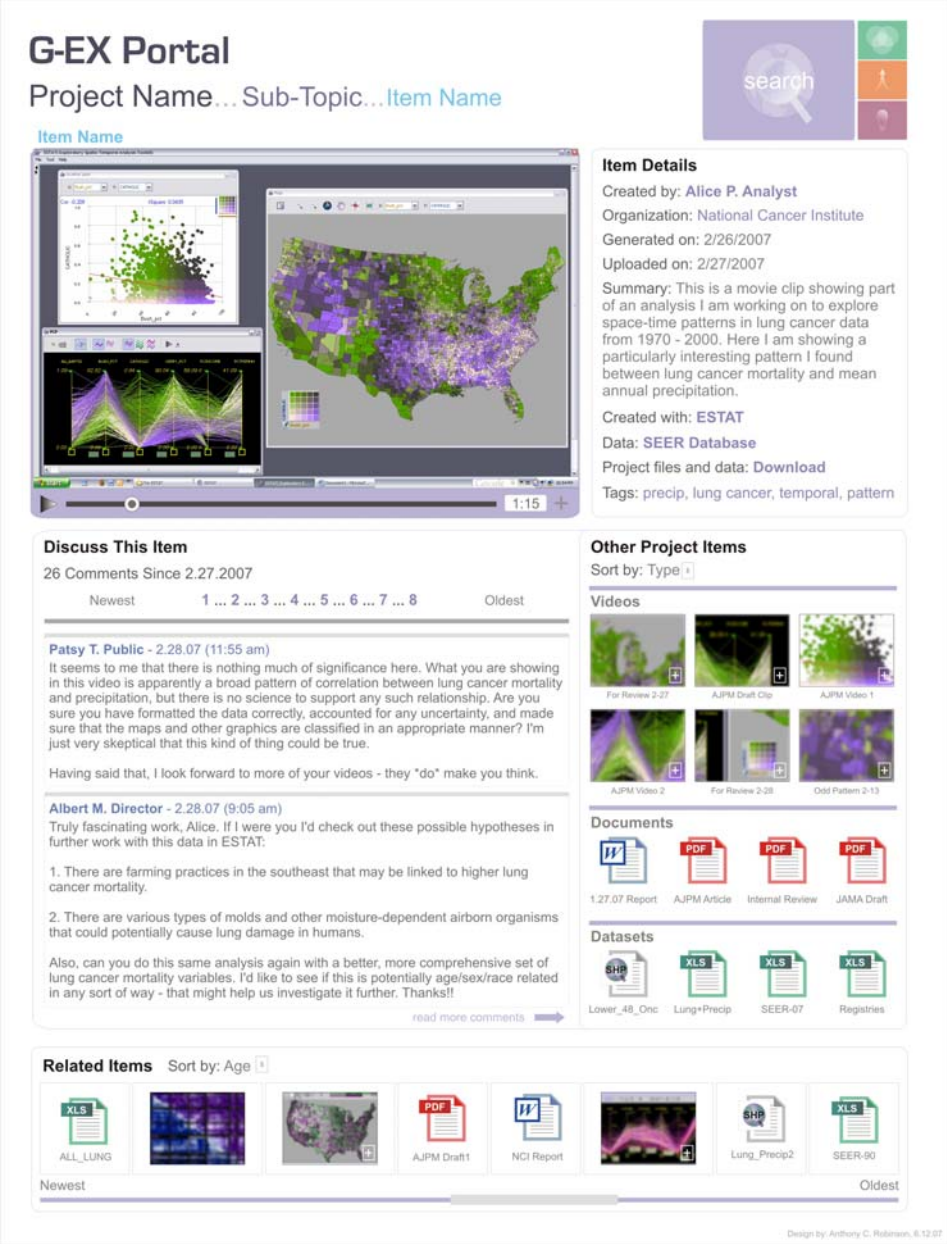


**Figure 2: The G-EX portal search module**

## G-EX Collaborate

Users who are actively engaged in collaborative work can make use of the G-EX Collaborate module. This module is designed to support basic different-place, different-time collaboration. Iterations are central to the form and function of the Collaborate module. Collaborators begin work by instantiating the first iteration, uploading media clips or other materials, and subsequent work is submitted as new iterations in the same thread. A visual track is provided to show the current iteration in light of past work, along with brief metadata and a thumbnail.

Discussion and file/project sharing are the primary means for collaboration using the G-EX Collaborate module. Users can provide a video clip to show what they have discovered, couple this media clip to its associated project files, and collaborators can have all of these materials to evaluate and revise. This works in a way similar to the G-EX Search module, however collaborators have the option in the Collaborate module to keep their work within their group unless and until they wish to share it publicly. Finally, the Collaborate module also features brief descriptions of each user and links to their personal profiles, ensuring direct access between collaborators in a unified web-based environment.

**G-EX Review**

The G-EX Review module is designed to support open peer-review for submissions to electronic journals. Users can upload a written paper along with video clips, datasets, and other relevant supplemental materials. These materials are then available to reviewers while they consider the submission.

An interface provides reviewers with the ability to rank the submission along a set of criteria provided by the journal editorial staff. Written responses to the submission can be added, and the entire review (once submitted) can then be browsed and viewed by other users. This process is inspired by the open review process followed by journals hosted by the European Geosciences Union (EGU) (http://www.copernicus.org/EGU/publication/open_access.html).

Quantitative rankings for each review can be visualized in the G-EX Review module using bar charts. Each review can then be summarized with a relatively small summary graphic, allowing users to browse quickly to a specific review. A running average of all scores can also be provided to summarize how well the paper submission has been received by all authors. This type of open reviewing has recently also been adopted by publications of the British Medical Journal (http://www.bmj.com/)

## Adapting Tools to Support G-EX

A major portion of our G-EX development focuses on adapting current tools to support output files that can be used in the portal. Few visualization environments provide portability options that would enable many of the features we propose for G-EX.

Currently we are implementing screen capture capabilities in our GeoViz Toolkit that will enable users to save captions and visualization configuration details using the Exchangeable Image File (EXIF) format (http://www.exif.org/). EXIF allows a header to be added to image files to describe its provenance. We are using this header to store captions and other information so that users only have to upload a single file to the G-EX Portal. Once the file has been uploaded, we can read out metadata with a server-side EXIF parser. We are also exploring other header options for audio and video file formats.

We are also adapting the Visual Inquiry Toolkit (VIT) to allow users to export interesting data subsets via the "pattern basket" interface it provides (Chen 2006). Users will be able to apply the VIT as a first cut against a large and intricate dataset, and then send the most promising subset of data to the G-EX portal for analysis and comment by others.

## Conclusion

The G-EX work in progress has the potential to positively impact investigator-to-investigator dissemination at NCI and other related agencies. The G-EX Portal will encourage investigators to share research artifacts back and forth to enhance dissemination of ideas, findings, and techniques.

We have recently completed initial designs for the G-EX portal, and implementation of the four G-EX modules will begin shortly. Development work has so far focused primarily on implementing export features into our existing geovisual analytics tools so that users can easily save and upload static and dynamic screen captures along with loadable descriptions of the tools that created them. Much work also lies ahead to develop the database needed to organize and serve the analysis artifacts that will populate the G-EX portal.

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cool tools. GuideK12 Geovisual Analytics. April 29, 2019. Where a student is coming â€œfromâ€ can matter both literallyâ€”and figuratively. Understanding geographic context blended with demographic and SIS data provides a powerful perspective for school administrators to make well-informed decisions. Whether it is for moving boundaries, adding programs, examining open enrollment or equity issues, geography matters.Â  And thatâ€™s exactly why GuideK12 geovisual analytic software earned top honors from The EdTech Awards 2019 program, winning the â€œBest Administrative Solutionâ€ Cool Tool Award. Their solution is designed exclusively for the needs of K-12 district leadership. and knowledge through innovative Geovisual Analytics techniques. Establish progress initiatives at international and. regional (sub-national) levels for measuring and collaborating, through statistical indicators, economic, social and enÂ  the design of class-based web applications. An emerging domain in web-enabled geographical application is the visualization of socio-economic information at de-. tailed territorial level in a way to enable both the analysis of regional differences and performance within a country and. comparison of different areas across countries.Â  torial level. The OECD regional database is available on the Statistical Portal at the OECD website, allowing users to. search and combine information on different sectors. G-EX falls into the broader context of geovisual analytics, a new research area with the goal of supporting visually-mediated reasoning about large, multivariate, spatiotemporal information. Because this information is unprecedented in amount and complexity, GIScientists are tasked with the development of new tools and techniques to make sense of it. Our research addresses the challenge of implementing these geovisual analytics tools and techniques in a useful manner. OBJECTIVES: The objective of this paper is to develop and implement a method for improving the utility of geovisual analytics software. The success of software is measured by its usability (i.e., how easy the software is to use?) and utility (i.e., how useful the software is). Here, we report on the development of the Geovisual EXplication(G-EX) Portal, a web-based application designed to connect researchers in geovisualization and related mapping sciences, to users who are working in public health and epidemiology. This paper focuses on the design and development of the G-EX Portal Learn module, a set of tools intended to disseminate learning artifacts. Initial design and development of the G-EX Portal has been guided by our past research on the use and usability of geovisualization in public health.Â  Results also revealed a willingness of users to contribute both learning artifacts and personal information that would help other users to evaluate the credibility of the learning artifact source. Interactive mapping and spatial analysis tools are under-utilized by health researchers and decision-makers as a result of scarce training materials, few examples demonstrating the successful use of geographic visualization, and poor mechanisms for sharing results generated by geovisualization. Here, we report on the development of the Geovisual EXplication(G-EX) Portal, a web-based application designed to connect researchers in geovisualization and related mapping sciences, to users who are working in public health and epidemiology. This paper focuses on the design and development of the G-EX Portal Learn module, a set of tools intended to disseminate learning artifacts.