VACCINE

Visual Analytics for Command, Control and Interoperability Environments
A U.S. Department of Homeland Security
Science and Technology Center of Excellence

VACCINE ANNUAL REPORT – YEAR 7

Addendum C - Flyers

JULY 1, 2015 – JUNE 30, 2016

Cooperative Agreement No. 2009-ST-061-CI0001

PURDUE UNIVERSITY

Homeland Security University Programs
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Coast Guard Search And Rescue Visual Analytics (cgSARVA)

Benefit: *cgSARVA is a vital component for analyzing and assessing operational efficiencies of different Coast Guard missions across the United States. The system aids with the risk assessment of potential staffing changes. The analyst will be able to understand the distribution of incidents, the risk, and the benefits involved with reallocation or reduction of resources.*

Mission Need

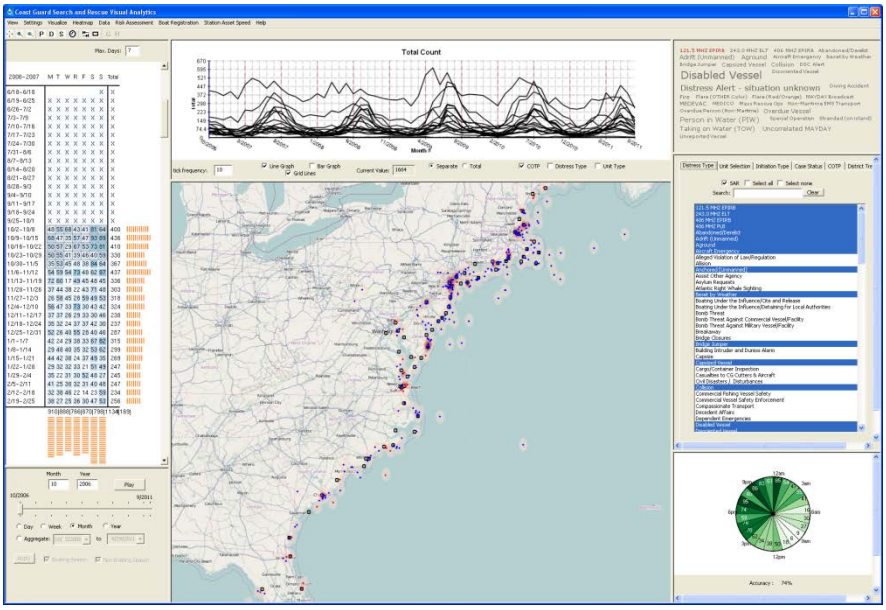
The Coast Guard Search and Rescue Visual Analytics (cgSARVA) is an interactive system that has been designed to assist U.S. Coast Guard decision makers and analysts in understanding and assessing the operational efficiencies of different Coast Guard missions at different organizational levels.

cgSARVA provides an interactive user interface and provides a suite of tools that enables the visualization, analysis and assessment of different Coast Guard missions. The system allows an analysis of the potential risks to the maritime environment associated with notional station closures and reallocation of different resources in terms of response time, potential lives and property lost, and provides optimal direction as to the nearest available station in case of such station closures. The system enables the analysis of trends, patterns and anomalies associated with the distribution of cases in both space and time conducted by the Coast Guard throughout the U.S.

The system has been developed utilizing a user-centered approach where the expertise of several different Coast Guard analysts and decision makers has been leveraged in the design process of the system.

Collaborators:

- *United States Coastguard (U.S. Coast Guard's Fifth District, Ninth District, Headquarters and Atlantic Area Commands)*



Linked views for spatiotemporal analysis of U. S. Coast Guard SAR cases. The main viewing area shows the map view with the points showing the locations of SAR incidents in the east coast of the United States.

Funded by:

- *U.S. Department of Homeland Security, Command, Control and Interoperability Center of Excellence*

Early Development — Lab Prototype — Commercial Product

For more information, contact:
Dr. David S. Ebert, ebertd@purdue.edu
http://www.VisualAnalytics-CCI.org

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Coastal Operations and Analysis Suite of Tools (COAST)

Benefit: *The visual analytics module of COAST delivers metrics based on station performance and coverage maps that allow the Coast Guard to analyze and assess operational efficiencies. The analysts use this information along with other modules of COAST to update their resource allocation plans, which can be tested and examined in the visual analytics module.*

Mission Need

The Coastal Operations and Analysis Suite of Tools (COAST) is a grand-scale effort from the Coast Guard to analyze their operations across the United States. VACCINE's current effort in the COAST project involves a visual analytic module and a resource coverage visual analytic model. In the future, the system will incorporate Boat Allocation Model data from Rutgers and support visual analysis of patrol boat routes. The system enables the analysis of case load and asset capacity per station that helps the analyst assess Coast Guard operational efficiencies based on station location and demand. The system also allows the visualization and analysis of case load and coverage for Coast Guard Air Stations.

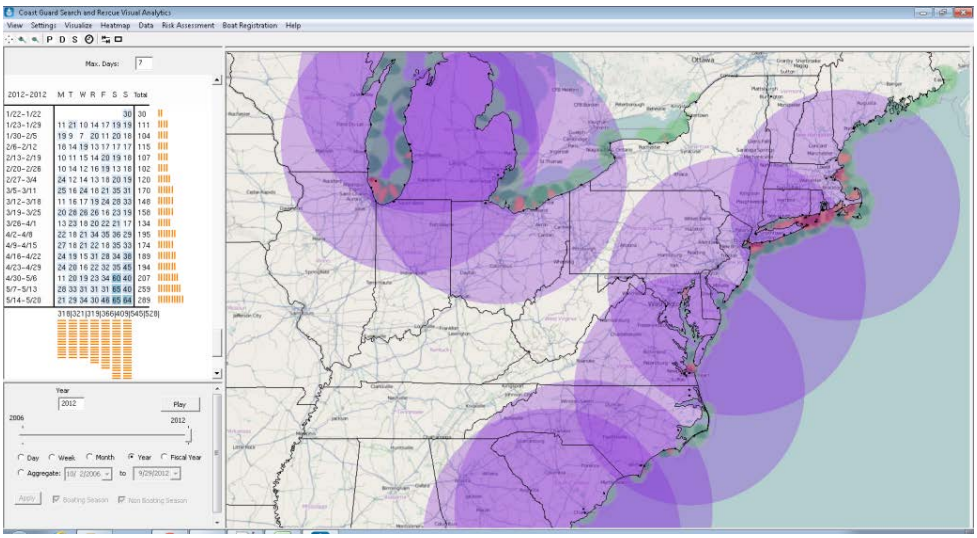
The COAST visual analytics module aims at supporting the development of a model to determine optimal performance for both boat and air stations. The system has been developed in a user-centered approach where the expertise of several different Coast Guard analysts and decision makers has been leveraged in the design process of the system. VACCINE's COAST module was officially verified and validated for use by the US Coast Guard in April 2013 and has been used in resource planning in the wake of Hurricane Sandy.

Collaborators:

- *United States Coastguard Headquarters (CG-771)*

Funded by:

- *U.S. Department of Homeland Security Center of Excellence*



Simulated boat and air coverage showing overlaps and gaps between stations.

Early Development — Lab Prototype — Commercial Product

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Surveillance Video Annotation Using Crowdsourcing

Goal

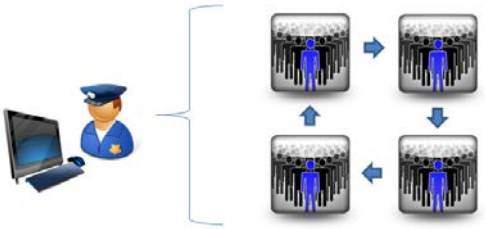
- Use crowdsourcing methods for a rapid analysis of surveillance video.

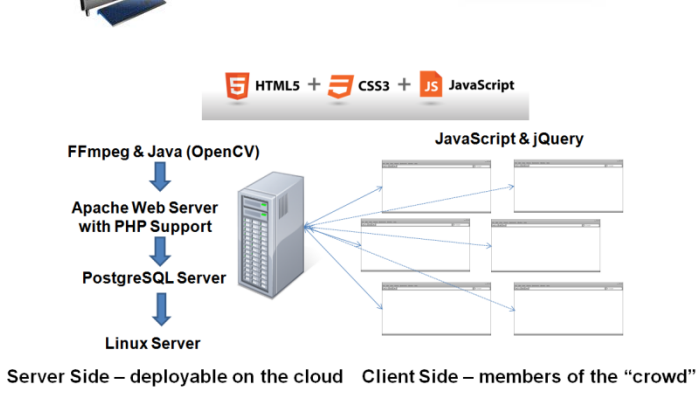
Approach

- A web-based system
- Video Annotation tools
- Crowd training and management
- Result Aggregation

System Overview

- A hierarchical model based on level of expertise, responsibility & security clearance.
- Officers can assign tasks, monitor training progress and reward the annotators.
- Temporal, Spatial and Real-time annotation capabilities for annotators
- Designed using HTML5, PHP, JavaScript and a PostgreSQL database server.





For more information, contact:

Professor Edward Delp
School of Electrical and Computer Engineering
Purdue University
ace@ecn.purdue.edu
Tel: 765-494-1740

https://lorenz.ecn.purdue.edu/~vat

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Disaster Situation Mobile Application

MADIS: Multimedia-Aided Disaster information Integration System
DSE: Disaster Search Engine

MADIS Benefit:

The proposed MADIS makes it easier for emergency managers to gather relevant information by automatically linking the situation reports directly to imagery obtained in the field.

Developer:

Florida International University

Data Layers:

- *Web-crawled dataset*
- *Disaster related images*
- *Situation document*

Thanks to the availability of mobile devices, emergency responders, supporting agencies and even private citizens can capture imagery of disaster events as they unfold. Once the crisis is contained, however, it's a daunting task for emergency managers to collect, organize and integrate disaster event data from multiple sources into incidence command systems where situation reports, incidence action plans, etc are being held. Therefore, we have developed a semi-autonomous system Multimedia-Aided Disaster information Integration System (MADIS), which uses advanced data integration and visual analysis techniques to associate temporal, spatial and other textual features of a disaster event situation report with event images and related text annotations.

Our prototype consists of a preprocessing component that catalogs disaster event related images and identifies relevant subject text in posted situation reports, training modules that establish the systems cataloging and text analysis capabilities, and a web-based database system with RESTful APIs that allow for support of both web or mobile device client applications. An iPad application (shown above) was developed based on the system framework. Figure (1) shows the main report list with thumbnail sized system associated related images; Figure (2) shows an open situation report with highlighted key words and the related images identified by the system;

Figure (1)

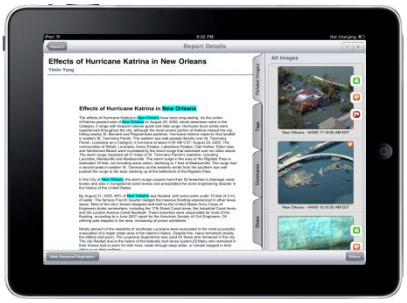

Figure (2)

For more information, contact:
vaccine@purdue.edu
http://www.VisualAnalytics-CCI.org

DSE Benefit:

A tool integrating multiple publicly sourced disaster information and provide versatile search functionalities, such as keyword-based search and vertical search with mapping.

Developer:

Florida International University

Data Layers:

- *General web pages*
- *Latest news and blogs*
- *Tweets*

Collaborators:

Miami-Dade County Department of Emergency Management

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Figure (3)

Figure (3) displays a selected image with description and allows the user to browse related images by using a image timeline or by content based retrieval.

Figure (4)

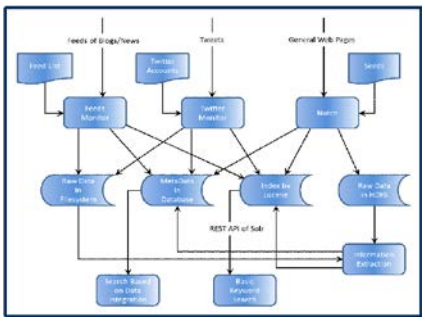
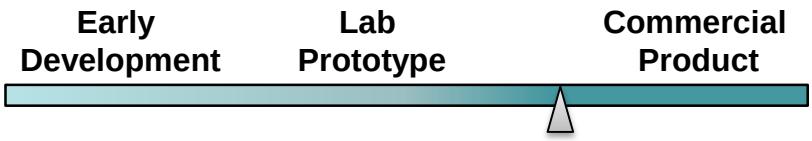


Figure (5)

Direct Search Engine (DSE) is an extended function of MADIS developed to quickly explore three different data sources: general web pages, latest news and blogs, and tweets, which are crawled by different tools and stored in different formats. To access the data for users, one method is to use the keyword based search, the other is based on data integration, and the results are presented as maps. Figure (4) presents the map results according to the keyword based search and different colors represents different numbers of returned results. Figure (5) depicts the proposed DSE system architecture.



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GARI

Gang Graffiti Automatic Recognition and Interpretation

Goal

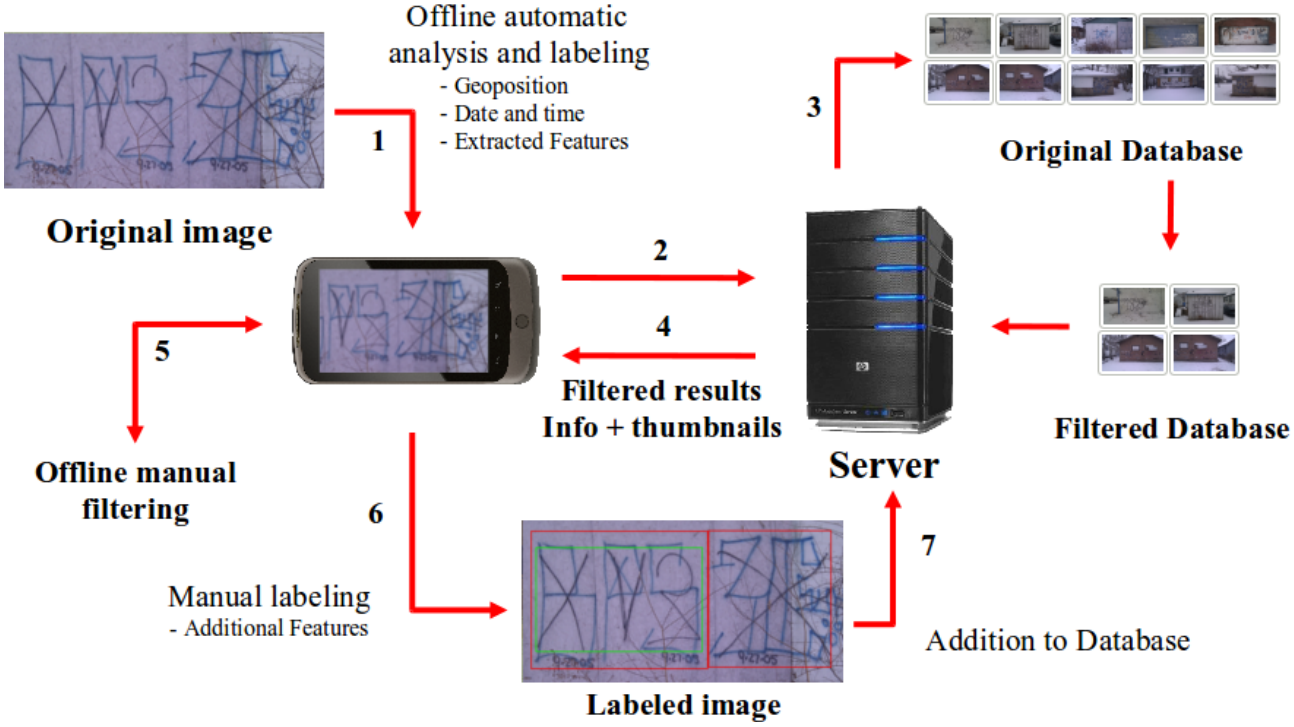
- Use image analysis techniques to identify, interpret and index gang graffiti and gang tatoo

Approach

- Image analysis
- User friendly interface
- Database of Graffiti Images

System Overview

- Automatic analysis and tagging: metadata (geoposition, date and time)
- Bidirectional communication with server: send images, retrieve and browse database, find similar graffiti/tattoo
- User input and review
- Android/iOS Operating Systems



For more information, contact:

Professor Edward Delp
School of Electrical and Computer Engineering
Purdue University
gari@ecn.purdue.edu
Tel: 765-494-1740

www.gang-graffiti.org

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Personnel:
Morteza Karimzadeh
Frank Hardisty
Jan Oliver Wallgrün
Yiting Ju
Scott Pezanowski
Prasenjit Mitra
Alan M. MacEachren

GeoVISTA Center
http://www.geovista.psu.edu/
The Pennsylvania State University

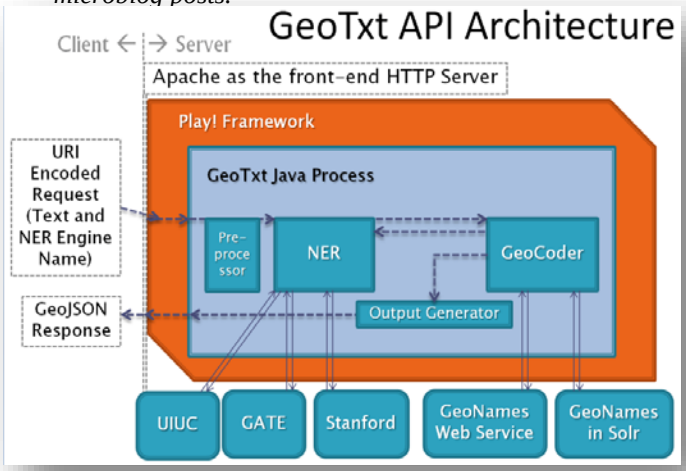
GeoTxt.org

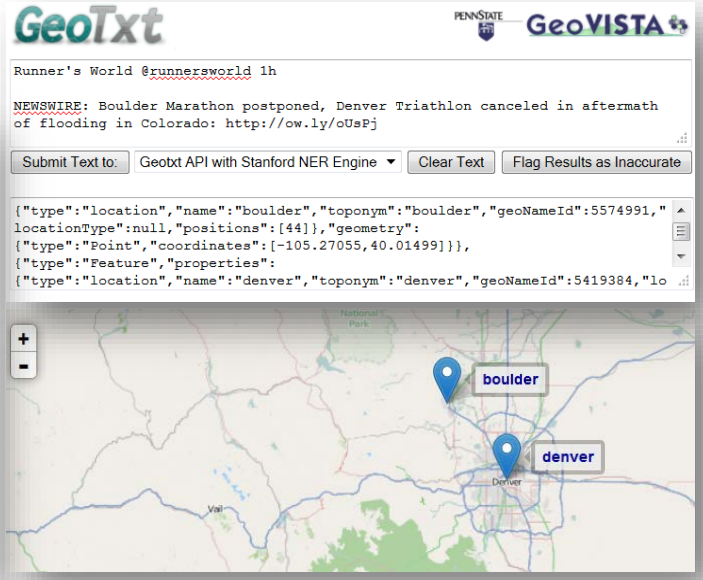
A Web Service to Geo-Locate Places in Microblog Posts and Other Textual Information Sources

In recent years, the amount of publicly available spatial data has grown tremendously, due in large part to the proliferation of GPS technologies and the location information integrated into web applications, especially social networking services. Networks like Twitter, Four-Square, and Facebook allow users to provide insights into current events in real time via short form textual updates or statuses. Many modern social networks provide a means to locate the contributor of status updates. The location of a contributor is typically given as geographic coordinates, latitude and longitude, but only a small proportion of users choose to turn "geolocation" on. With Twitter, for example, 98.5% of tweets lack explicit location information. But, there is a wealth of place-relevant information in text that is not explicitly geolocated; that information comes in the form of linguistic references to named places and place-specific features. This spatial information, along with the temporal information inherent to status updates, enables spatial and temporal analysis of contributor patterns.

GeoTxt.org is a web service that enables the geolocation of places, people, and organizations described in common status updates from online social networks, as well as from other text sources such as news stories, status reports, and blog posts. It uses techniques from a wide array of research areas – applied linguistics, natural language processing, search engine optimization, and geographic information science – to parse out places, people, and events explicitly or implicitly mentioned in text (e.g., in Twitter Tweets) and then to analyze and contextualize these entities to locate them in geographic space. The API is designed to be integrated into the development of dynamic, map-based, visual analytical interfaces, specifically in the context of crisis management and emergency response. As a proof of concept, GeoTxt now provides place recognition, disambiguation, and geolocation for SensePlace 2 (a situational awareness monitoring application developed in the GeoVISTA Center).

Benefit: *GeoTxt detects locations, people, and organizations mentioned within text and assigns geographic coordinates to those locations. This enables references to geographic locations that appear in public posts on social networks, in newspapers, and in other text sources to be harnessed for a variety of analytical tasks. GeoTxt is specialized to cope with the challenges of extracting and geolocating entities accurately from short microblog posts.*





Figures: Diagram of the GeoTxt API architecture (left). On the right, a Tweet about current events is pasted into GeoTxt and parsed to geolocate place names mentioned (top). Those extracted locations are displayed on the map below.

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Jigsaw

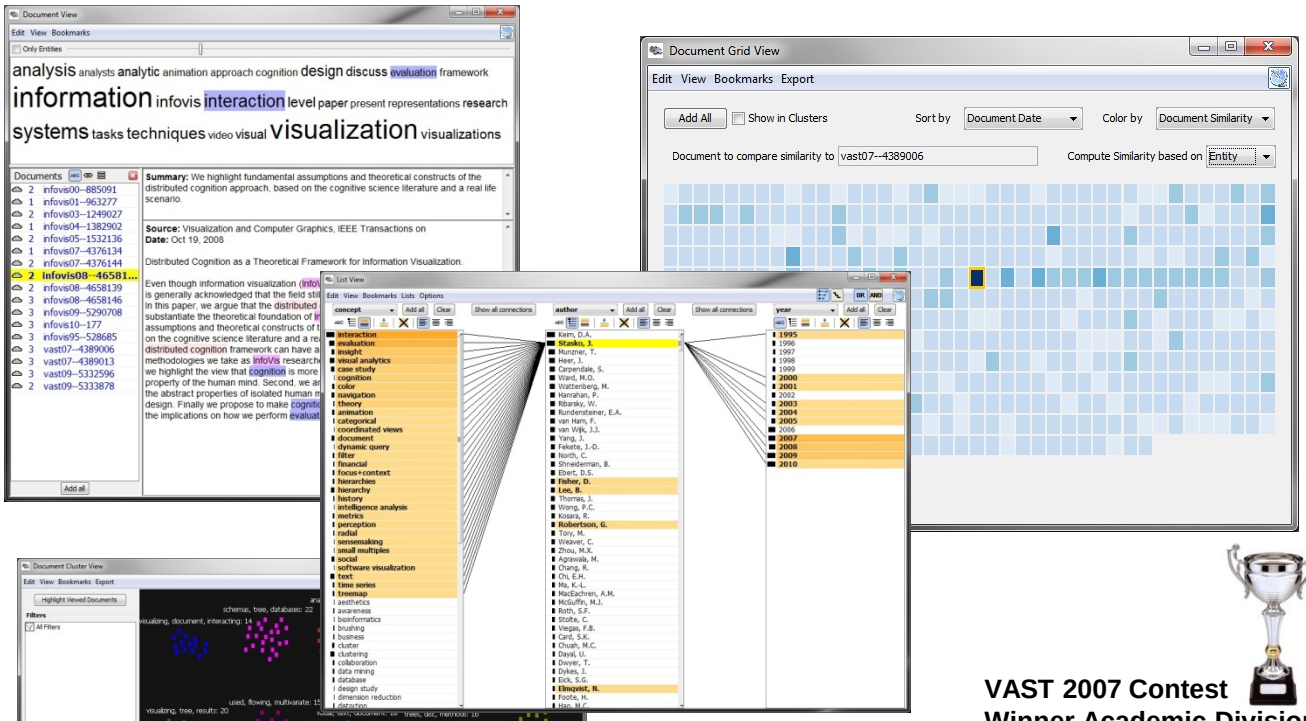
Visual Analytics for Investigative Analysis on Document Collections

Goals

- Help investigative analysts explore, analyze, and make sense of unstructured and structured document collections
- Support the discovery of hidden and embedded relationships across the documents

Approach

- Identify entities such as people, organizations, and places within a large document collection
- Highlight connections between entities
- Provide a "visual index" on those entities to guide the analyst to relevant reports



VAST 2007 Contest
Winner Academic Division

Jigsaw Features

- Multiple connected views
- Analysis support for structured and unstructured data
- Computational text analysis including document summarization, sentiment, similarity and clustering
- Visualizations showing different aspects of the document collection
- Rich interactive user interface

For more information, contact: John Stasko, stasko@cc.gatech.edu

School of Interactive Computing
Georgia Institute of Technology

Documentation, papers, datasets, scenario , tutorial videos and download link can be found on the Jigsaw webpage:
http://www.cc.gatech.edu/gvu/ii/jigsaw/

For more information, contact:
vaccine@purdue.edu
http://www.VisualAnalytics-CCI.org

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MERGE

Mobile Emergency Response GuidE

Goal

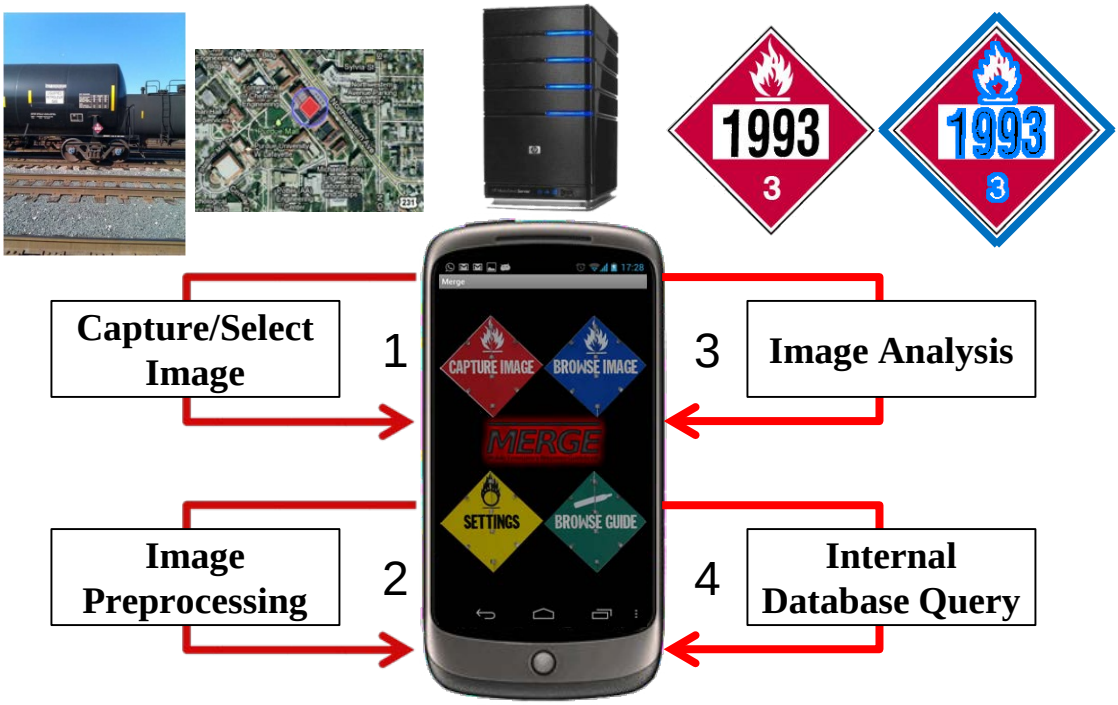
- develop a mobile-based system that uses location-based services and image analysis methods to automatically interpret the hazmat sign and quickly provide guide information to users

Approach

- Image analysis (saliency detection, object recognition) with user friendly interface
- Querying database of 2012 emergency response guidebook (ERG)

System Overview

- Capture/select image from mobile devices
- Image preprocessing on mobile devices
- Automatic image analysis
- Communication with backend server
  - send images, retrieve analysis results
- Internal database query
  - UN identifier, class, symbol, or color
- Display emergency response information
- Android/iOS mobile apps available



For more information, contact:

Professor Edward Delp
School of Electrical and Computer Engineering
Purdue University
merge@ecn.purdue.edu
Tel: 765-494-1740

www.hazmat-signs.org

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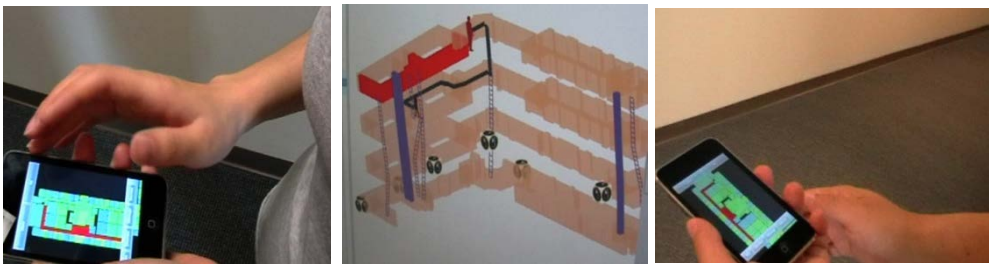
Mobile 3D Routing, Emergency Evacuation, and In-Field Criminal Investigative Analytics

Benefit: *This technology allows emergency responders to transmit or receive location information, plot 3D routes between locations, and find alternate routes if there are blocked paths. This system is designed to simulate large scale evacuations along multiple routes in a responsive and situationally aware manner.*

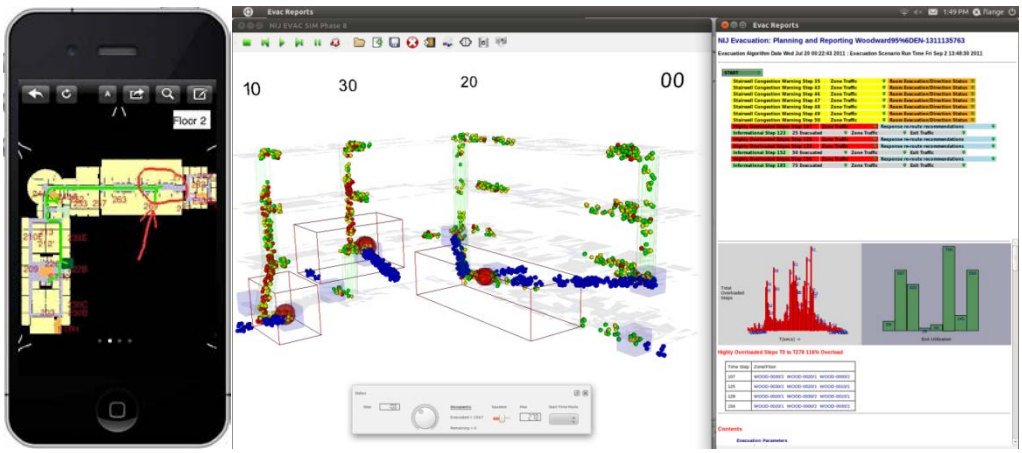
Collaborators:

- *UNC Charlotte*
- *National Institute of Justice*
- *UNC Charlotte Police*
- *UNC University System*
- *Charlotte-Mecklenburg Police Department (CMPD)*
- *DHS CAUSE-ERE*
- *NC A&T*

We have developed a mobile application for situationally aware emergency response in dense urban environments that have tall and large buildings. Using an iPhone or other mobile device, an emergency responder can transmit or receive location information, plot 3D routes between locations, and find alternate routes if there are blocked paths. All this can be done, shared among other responders, and received instantaneously. Thus the emergency responders and the command center all have situational awareness and comprehensive, personalized routing. Routing can also be extended from inside the building to the surrounding environment, enabling the system to handle larger scale evacuation along multiple routes in an efficient manner. As a first application, we have generated 3D graphs for all the academic buildings on the UNC Charlotte campus and embedded them in the street network. This environment can also be used to stand in for a dense urban neighborhood. We participated in the DHS Canada-US Experiment (CAUSE-ERE) based in Seattle for response to a Northwestern earthquake and will participate in follow-up activities. We are also working with the Charlotte-Mecklenburg Police Department (CMPD) to develop a training exercises using this environment. This exercise will permit us to test our system, our routing capabilities, and our mobile interfaces with real police officers. We will gain valuable feedback and evaluations of our system, which will be used to improve it. We have also run an on-campus shooter/emergency evacuation exercise with the UNC Charlotte Public Safety Department. The improved system will be tested with other police departments and is being deployed with UNC Charlotte Police, CMPD, and others.



From left to right: blocked hall selection and alternate route, full 3D representation of alternate route in building, receipt of blockage and routing by second user.



Left, close-up of mobile interface with search area drawn and sent to mobile user. Right, Evacuation model in left window with selected automatically generated congestion events (upper right window) indicated within boxes. New blockages can be inserted and the model updated in real time.

For more information, contact:
ribarsky@uncc.edu
vaccine@purdue.edu

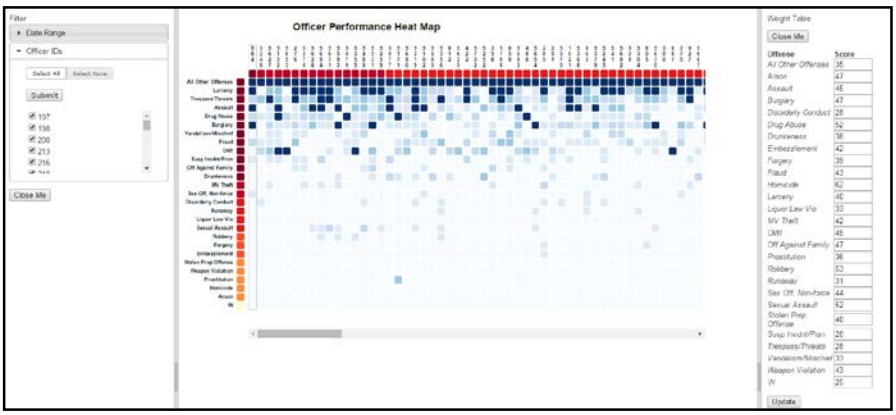
Fantasy Cop – Visual Metrics of Officer Performance

Goal:

In order to facilitate law enforcement agencies to evaluate performance of officers, we developed a web application fantasy cop. Our visual analytics application enables supervisors to interactively develop customized metrics to evaluate the performance of officers, understand officer activity patterns and performance trends. Through the process of explore the data, supervisors can find out the factors that can improve operational decision making. The project is currently under development and is being tailored for the Lafayette, IN police department.

How it works:

Users can filter the date range and officers that they are interested in, and modify the weight values for different offenses. The colored matrix view matches the result values into predefined color map.



The matrix view shows the sorted results of officer performance in a descending order from left to right.

Benefits:

This web application provides a matrix view with colored cells to facilitate the process to compare the performance of large groups of people. Users can sort the matrix based on individual person or specific metrics. This visualization tool support a convenient method to explore the activity patterns and performance trends.

For more information, contact:

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Operational Risk Assessment Module Visualization (ORAM)

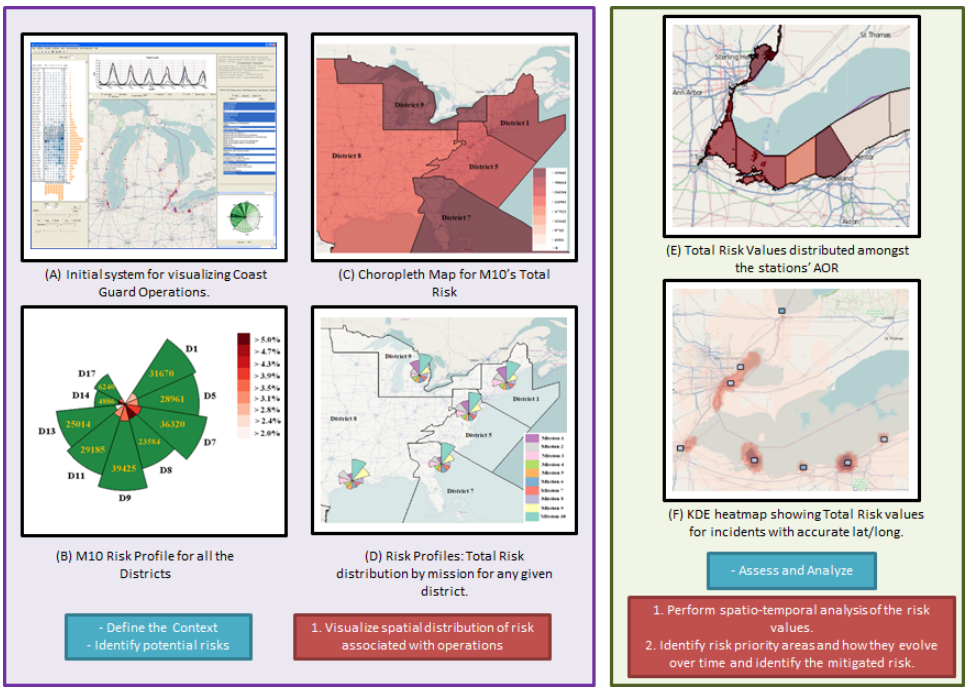
Benefit: *An interactive visual analytics system to visualize the Coast Guard operational risk assessment models and provide risk analysis that supports the distribution of resources and enables the optimization of limited assets. This tool enables decision makers to explore, analyze, drill-down, and quickly assess performance, targets, and return on investment of operations across missions and districts.*

Mission Need

The Coast Guard Atlantic Area Command developed the Operational Risk Assessment Model (ORAM) to support mission planning and analysis of the 11 Coast Guard missions at the operational level. The model calculates and compares risk among Coast Guard missions and geographical areas and produces a calculated risk index number (RIN) that allows for a common measurement across different areas.

VACCINE improved the cgSARVA framework to create geographical visualizations to support the trade off decisions that the model is aimed to address. An interactive visual analytics system can help derive insights from large amounts of data and facilitate the risk management process thereby providing a suitable solution.

An interactive visual analytics system can also assist analysts and decision makers in long term planning and assessment of mitigation strategies. Our system provides multiple linked views to perform spatiotemporal analysis of risk, integrated techniques and components to visualize and identify risk priority areas, spatial distribution of RIN values, and perform coverage efficiency analysis. All of these components are integrated to provide a complete risk picture to the analyst.



Visual analytics components that support ORAM risk visualization and analysis (showing synthetic data).

Collaborators:

- *United States Coastguard Atlantic Area Command.*

Funded by:

- *U.S. Department of Homeland Security Center of Excellence*

Early Development — Lab Prototype — Commercial Product

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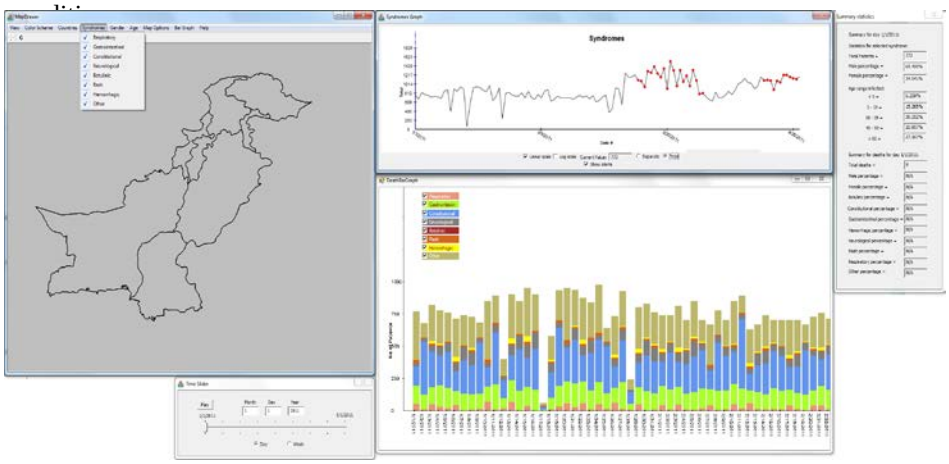
VISUAL ANALYTICS ENVIRONMENT FOR PUBLIC HEALTH SURVEILLANCE

Benefit: *A visual analytics environment for public health surveillance that can be used by health officials to identify emerging health threats in an area using chief complaints data collected by hospitals. The system can detect anomalies in temporal plots of syndromic surveillance.*

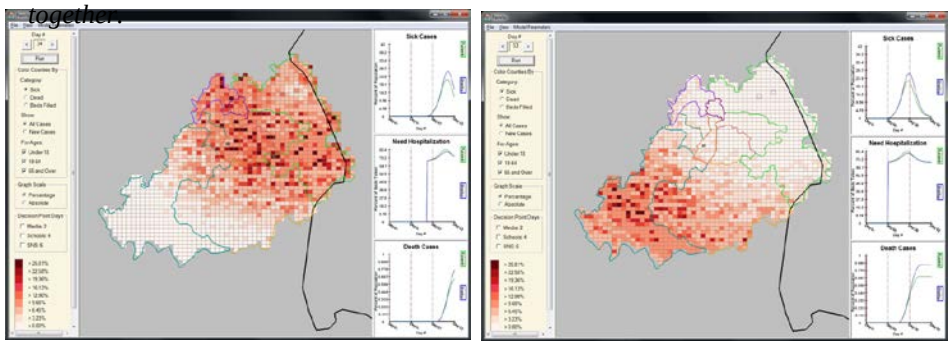
Users can also interactively explore different epidemic models and corresponding epidemic spread data in a spatiotemporal map view.

Mission Need

Assessing current and emerging public health threats is important for public health officials in order to make decisions regarding mitigative actions and allocation of resources. It also helps scientists understand the characteristics of syndromic diseases and improve their models. Patient hospital admittance records are first classified into 7 syndromes (Botulinic, Constitutional, Gastrointestinal, Hemorrhagic, Neurological, Rash, Respiratory), then the categorized data is passed to different linked components of the system. In the time series plots, EWMA control charts with a 99% confidence interval upper bound are used to identify anomalies in the data represented by red dots in the temporal plots. Hospital admittance data is also geocoded and can be used to identify any spatiotemporal patterns. Our system also allows the analyst to explore different epidemic models and visualize the spread of an epidemic in any geographical region using spatiotemporal view under certain



(Middle) Line Graph view showing health alerts for selected syndrome and region. Alerts shown fall within the 99% confidence interval for EWMA control chart. Stacked graph view shows the contribution of each type of syndrome. (Right) Summary statistics view provides details about illnesses with respect to age, gender and chief complaint. (Left) Map view. Time slider that links all the views together.



Linked Geospatial and Statistical view showing the spread of Pandemic Influenza in Lahore, Pakistan.

Early Development — Lab Prototype — Commercial Product

Collaborators:

- *Distributed Multimedia Systems Laboratory, Purdue University*
- *King Edwards Medical University, Lahore, Pakistan*
- *University of Engineering and Technology, Lahore, Pakistan*
- *VADER Lab, Arizona State University*

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Defense Threat Reduction Agency
Award Number HDTRA1-10-1-0083

For more information, contact:
vaccine@purdue.edu
http://www.VisualAnalytics-CCI.org

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VISUAL ANALYTICS DECISION SUPPORT ENVIRONMENT FOR EPIDEMIC MODELING AND RESPONSE EVALUATION

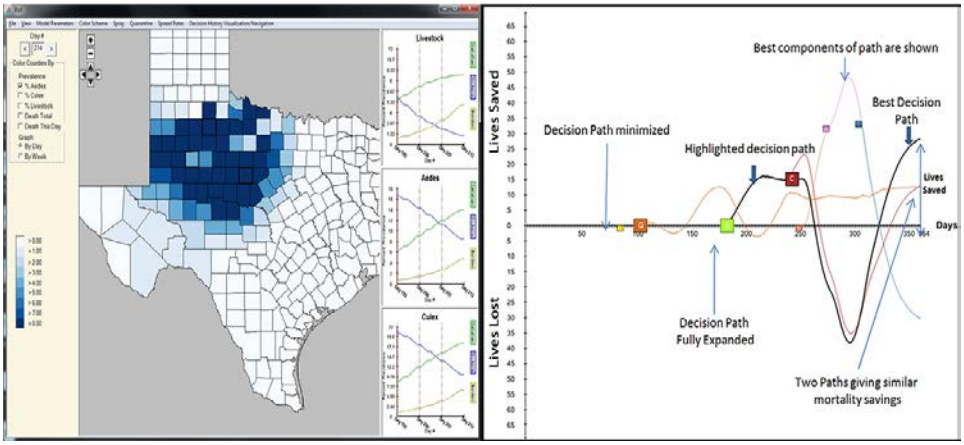
Benefit: *Interactive decision support environment in which users can explore epidemic models and their impact. This environment provides a spatiotemporal view where users can interactively utilize mitigative response measures and observe the impact of their decision over time. Our system also provides users with a linked decision history visualization and navigation tool that support the simultaneous comparison of mortality and infection rates corresponding to different response measures at different points in time.*

Mission Need

With the ever increasing threat of potential mass causality events like epidemic outbreaks (e.g. Rift Valley fever, Pandemic Influenza), public health officials must prepare, exercise and evaluate complex mitigation plans. The planning stages often rely on knowledge gained during exercises or information provided via complex modeling. Moreover, such plans are often developed with only a few specific scenarios in mind and often ignore the fact that the solutions dealing with a disease outbreak are very dependent on its underlying traits and actual characteristics, which may not be known *a priori*. Analysts need to work in an environment where they can analyze the future course of an outbreak, evaluate potential disease mitigation strategies and prepare effective mitigation plans. In order to help analysts overcome these issues, we have developed an interactive decision support environment in which analysts can explore epidemic models (e.g., Rift Valley fever, Pandemic Influenza etc.) and their impact, interactively utilize mitigative response measures and observe the impact of their decision over time under varying scenarios. In addition, analysts can also utilize doubly-linked, decision history visualization & navigation tools that can link to multiple simulation runs and provide simultaneous comparison of mortality & infection rates. Such a functionality helps analysts design an optimal mitigative response strategy under varying epidemic outbreak scenarios. Analysts will have a clear understanding of the effects that certain responses will have. In order to demonstrate our tools, we have integrated two unique epidemiological spread models. i.e. Rift valley fever and Pandemic Influenza.

Collaborators:

- *Purdue University*
- *Foreign Animal and Zoonotic Disease Defense Center*



(Left) The spatiotemporal model view. Users can watch the spread of the model over space and time and introduce changes to the simulation as well as incorporate mitigative response. (Right) The decision history tree view. As users interact in the model view, the different paths the simulation can take are calculated and visualized. The decision paths are plotted over time on the x-axis, with the y-axis representing the cumulative deviation from the baseline simulation.

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- *US Department of Homeland Security*

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Case Study 1 – Pandemic Influenza

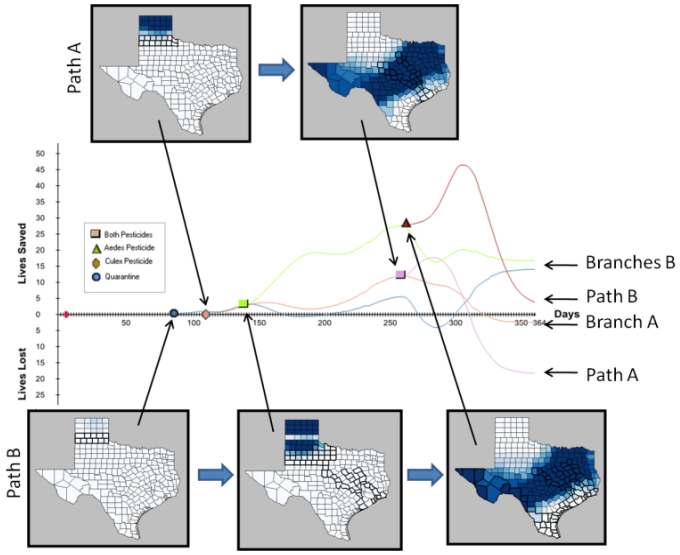
Our first epidemiological spread model utilizes a Gaussian mixture model that simulates the spread of a pandemic influenza across the united states starting from a user defined point source location and incorporating airport traffic models. Within our modeling tool, analysts can choose from three global decision measures: (1) school closures; (2) media alerts; and (3) strategic national stockpile deployment (SNS).

In this model, all decision measures are designed to mitigate the spread and each mitigative response measure can be deployed only once. Applying these decision measures in different combinatorial order can yield different mortality and infection rates. Bottom figure shows four different exploration paths, user has created. We have included a variety of decision measures along each path, including combinations of all three mitigative response. The maps surrounding the decision tree structure represent day 45 of the simulation with respect to a given decision path as indicated by the labels. Here, we can quickly see that path D1 is the optimal choice in terms of mitigating the outbreak based on the available decision metrics. The sequence of mitigative measures represented by this path saves maximum number of lives as compared to other paths.

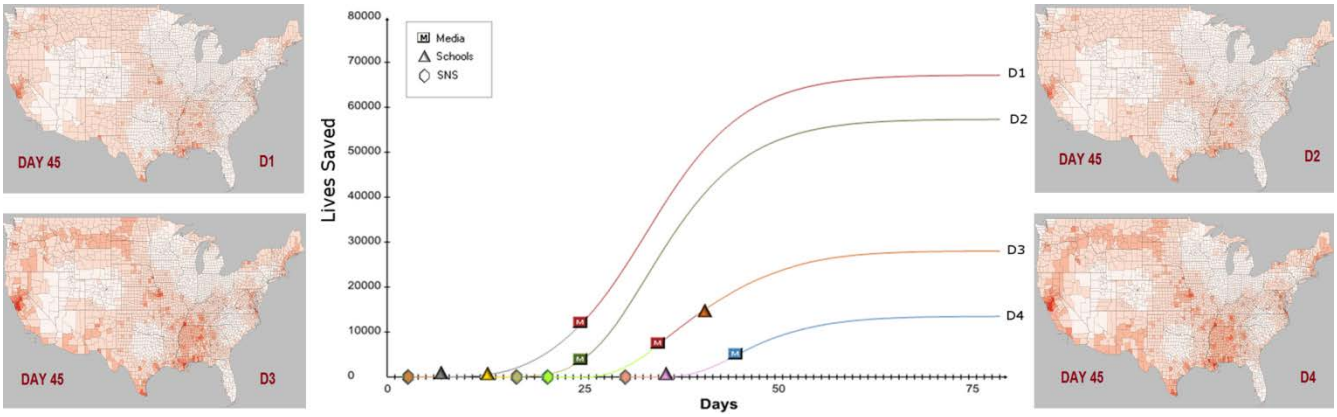
Case Study 2 – Rift Valley Fever (RVF)

Our second epidemiological spread model utilizes a differential equation model that simulates the spread of RVF through a simulated mosquito and cattle population in Texas. Users can choose from two mitigative response measures (1) pesticides; and (2) quarantine. Users are able to interactively apply a quarantine or pesticide spray to any individual county or multiple counties at once during the simulation. Analysts can combine Aedes and Culex pesticides for a combined spray.

Figure (below) shows that user has created different paths for exploration. Each path branches off from the base path whenever user performs a mitigative measure. It can be seen from the figure that path represented by green color saves maximum number of lives as compared to other paths. Path A performs worst and ends up even below the baseline simulation (which represents the absence of any mitigative measure).



Rift Valley fever Case Study. Here the user has introduced a variety of different decision measures at various points in time and in different combinatorial order. We explore the resultant simulation spaces in the geographical space with the maps surrounding the central image. Each map corresponds to a different decision tree branch as denoted by the corresponding label.



Pandemic Influenza Case Study. Here the user has introduced a variety of different decision measures at various points in time and in different combinatorial order. We explore the resultant simulation spaces in the geographical space with the maps surrounding the central image. Each map corresponds to a different decision tree branch as denoted by the corresponding label.

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Goal:

Campus security and police departments have implemented a multitude of safety precautions, including CCTV cameras. The efficiency and effectiveness of using CCTV camera resources for preventing crimes result in higher demand. This visual analytics tool facilitates to analyze the existing CCTV camera resources and suggest improved allocation schemas based on blind spots and crime data. It also provides the user with an interactive safe path calculation method for walking purpose on the basis of the maximum monitoring area.

How it works:

Safety in view provides the user with an interactive path planning tool on the map. It also voids buildings in the calculated path is an optional control factor. The camera-alarming function highlights the cameras that a specific crime occurred in their visible range. The camera-ranking function highlights the camera that records the largest number of crime incidents. Based on the historical crime data, we suggest locations for future camera installation.

(A)Screenshot of our Safety in View tool that safe paths for pedestrians, and suggests new CCTV camera installation locations for law enforcement agencies.(B)Mobile screenshot of our Safety in View tool.

Benefit:

Our Safety in view has two major benefits. For pedestrian safety, it utilizes CCTV coverage data to plan a safe path. This path is modified with maximum coverage by camera viewing angles. Interactive function is provided for user to adjust the result path. For law enforcement, the safety in view optimize current coverage of CCTV cameras based on crime, traffic and civil incidents reports. It is able to identify specific camera for monitoring a specific area and identify the camera that captures the most crimes for a period of time.

For more information, contact:

Your Partner Institution Contact Information Here

SMART: Social Media Analytics and Reporting Toolkit

Benefit: *This technology provides analysts with scalable and interactive social media analysis and visualization through topic extraction, combination of filters, cluster examination, and stream categorization. These components are tightly integrated into a highly interactive visual analysis workbench, that allows an analyst to observe, supervise, and configure the methods in each individual analysis process.*

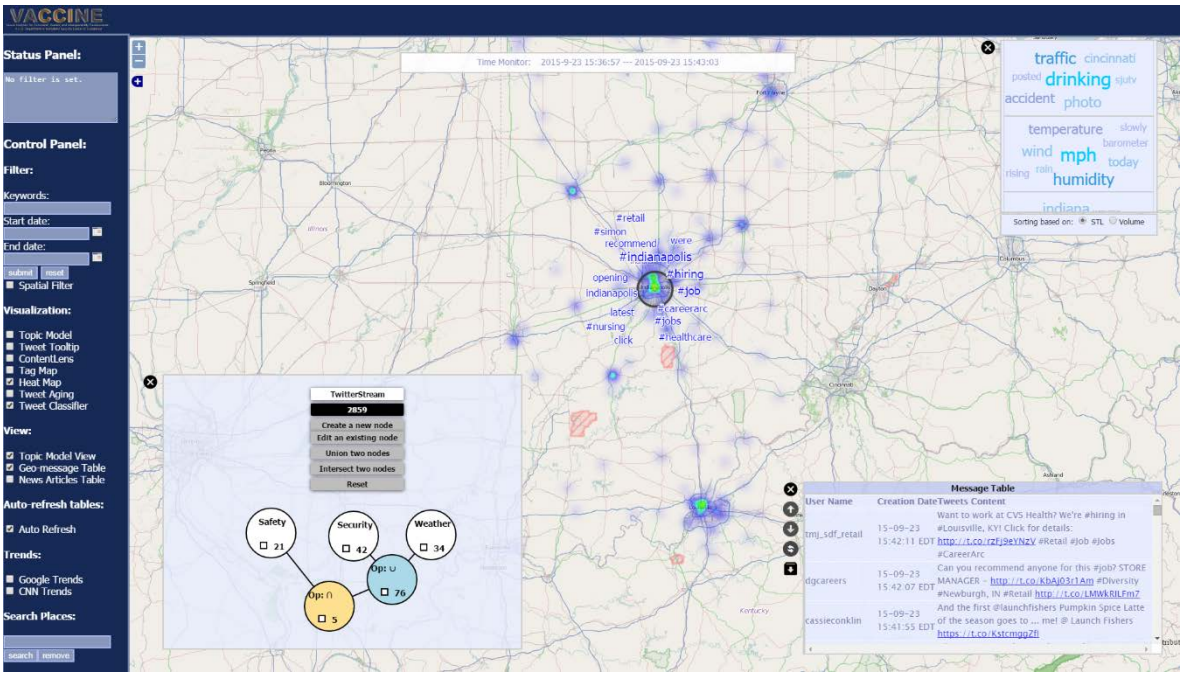
Collaborators:

- *University of Stuttgart*
- *Purdue University*

Mission Need

Recent advances in technology have enabled social media services to support space-time indexed data. Such spatiotemporal data has immense value for increasing situational awareness of local events, providing insights for investigations and understanding the extent of incidents. However, the large volume of unstructured social media data hinders effective exploration and examination. Analysts require new methods for monitoring their topics of interest, identifying trends and anomalies, and dealing with the data volume and its dynamic nature.

SMART system provides users with scalable and interactive social media data (e.g., Twitter and Instagram) analysis and visualization, which includes real-time monitoring of social media channel, extraction of trending and abnormal topics, density based spatial clustering, and task-tailored interactive message categorization. In addition, web and news media sources are incorporated in the system so that users can search news articles of interest. Our system also provides an email alert/summary service to automatically send emails related to user-defined topics. We provide such functionalities through not only desktop application, but also highly interactive and accessible Web interfaces.



SMART system includes a map view, a topic view, a stream classifier view, and a message table. The classifier view loads traffic, severe weather and safety classifiers, and allows users to create or modify the classifiers. By clicking a classifier, other linked views refresh to show corresponding data. Contentlens in the map view visualizes prominent keywords extracted from tweets inside the lens.

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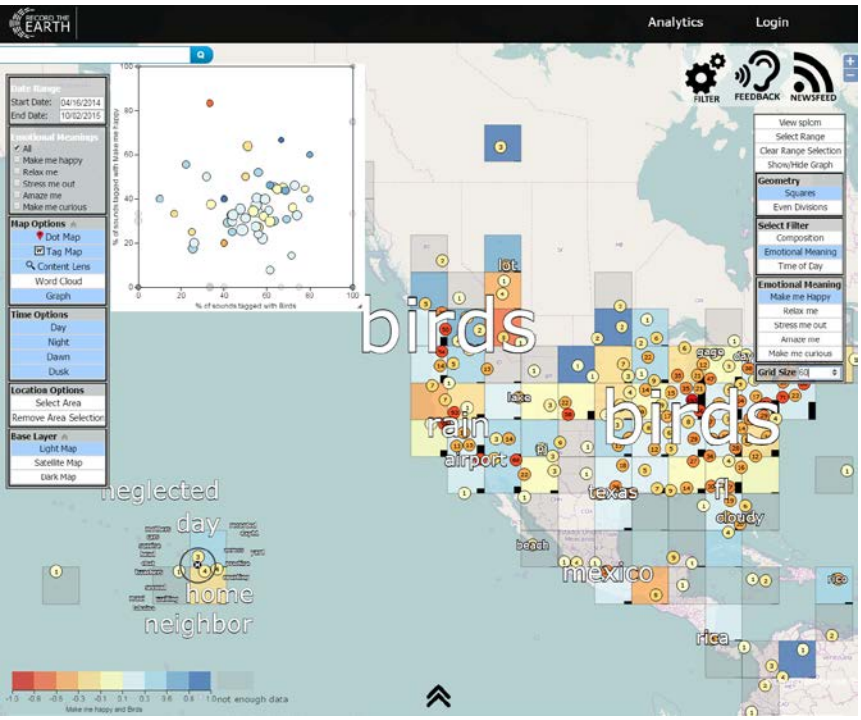
Global Soundscapes



Soundscapes map showing dot map, tag map, content lens, and a scatter plot comparing the "wind" and "relax me" tags

Global Soundscapes is a website that allows people to explore information about sounds. There is an app that people can download to their phones that allows them to upload sounds to our database along with the location they were uploaded from, a description they write about the sound, and any of several tags relating to the content of the sound and how the user felt about it. The goal of the Global Soundscapes website is to provide an interactive tool to allow people to browse through the sound data and find interesting trends.

Dot Map

- Sounds displayed as points on a map
- When one of the points is clicked it plays the sound
- If two or more points are close together on the map they are grouped together into clusters
- Clusters have the number of sounds they contain written on them

Filtering options

- Time of day the sound was uploaded
- Emotional meanings the sound was tagged with
- Search bar that selects only the sounds with the search terms in the description
- Time slider that shows how many sounds were uploaded each day since the project started and can be used to select a date range so only those sounds are shown

Tag Map

- Shows the most common word at locations across the whole map

Content Lens

- Shows the top few words within a small area

Word Cloud

- Shows the most common words independent of location

Scatter plot

- Breaks the map into segments and graphs the percentage of sounds tagged with one tag and the percentage of sounds with another tag
- Select an area on the map for the graph to use the sounds from or it will use all the sounds within the current viewing window
- The graph has 2 options for breaking up the map
- Grid with squares of a uniform pixel width
- Divide the screen in half recursively until there are less than a certain number of sounds in each section

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For more information, contact:
soundscapeapp@lists.purdue.edu
https://recordtheearth.org

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Symbol Store

Personnel:
Alan M. MacEachren
Anthony C. Robinson
Scott Pezanowski
Justine Blanford
Frank Hardisty
Josh Stevens

GeoVISTA Center
Penn State University

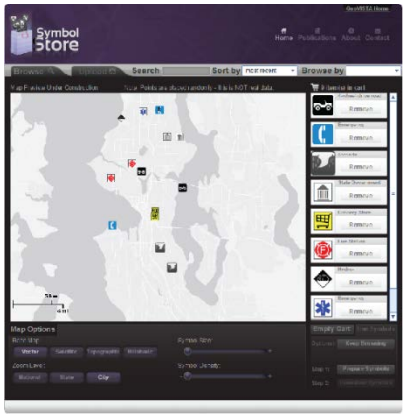
Supporting Map Symbol Interoperability

A number of agencies within DHS employ maps as part of their daily operations. To facilitate inter-agency communication, cooperation, and consistency with map-based information and tools, DHS has supported research on map symbol standardization by Penn State's GeoVISTA Center since 2009. The goals of this research include:

1. Investigating the use and usability of the ANSI INCITS 415-2006 standard
2. Developing a process to refine mission-specific symbol standards
3. Enabling the sharing of symbols through a feature-rich online "Store"
4. Determining appropriate map symbology for mobile use within DHS

Main Features include:

- **A** Keyword-based **symbol queries**.
- **B** Browse symbols by **agency**, **set**, or **organization**.
- **C** **Interactive metadata:** clicking on items generates new search.
- **D** Users can add desired symbols to the **cart**.
- **E** **Preview selected symbols on a map** before downloading.



The map preview feature includes several base maps

Try the Symbol Store at: http://www.symbolstore.org

The Symbol Store

The Symbol Store supports map symbol interoperability by allowing users to search, choose, and download symbols from a growing collection that currently exceeds 2,400 map symbols.

Each symbol in the database is enriched with detailed metadata that includes category, agency, organization and set, rating, symbol description and user-submitted tags. Once a search is returned, users can browse through results and can add the desired symbols to their carts. The map preview function allows users to see their chosen symbols on a variety of map types before downloading.

For convenient use in other mapping projects, symbols are uploaded and downloaded in the Esri style Format. A wider variety of symbol formats, including SVG and PNG images, will be supported in updates in the near future. The web services that make the Symbol Store possible are also open to other developers, enabling a multitude of cross-platform mapping applications.

E-Symbology Portal

Most DHS mission areas used separate in-house symbol sets for internal standards. With the e-Symbology Portal, a web-based environment where topics can be polled and discussed by remote participants asynchronously, those standards are collaboratively refined. Pairing this refinement process with the Symbol Store service allows users to seamlessly organize their symbols, and upload them for others to find and use for their own projects.

Symbology for Mobile Devices

In response to the growing need for DHS missions to be carried out on cell phones, tablets, and other mobile devices, the GeoVISTA Center has produced a new set of map symbols specifically designed for mobile devices.

Experiments on mobile device use and comparisons between the new mobile symbols and the existing HSWG set are currently underway.

For more information, contact:
maceachren@psu.edu | vaccine@purdue.edu
http://www.VisualAnalytics-CCI.org

TRIP: Travel Response Investigative Profiler

Benefit: *TRIP is an ongoing project initiated to provide the prediction of individuals' movements through an integrated spatiotemporal visualization, exploration and analysis of multiple individuals' movement histories. Various geo-spatial and temporal cues are incorporated onto the map without using separate views. In the future, correlation analysis among individual movements and infrastructures would provide users with tools of modeling individuals' movement patterns.*

Functionality:

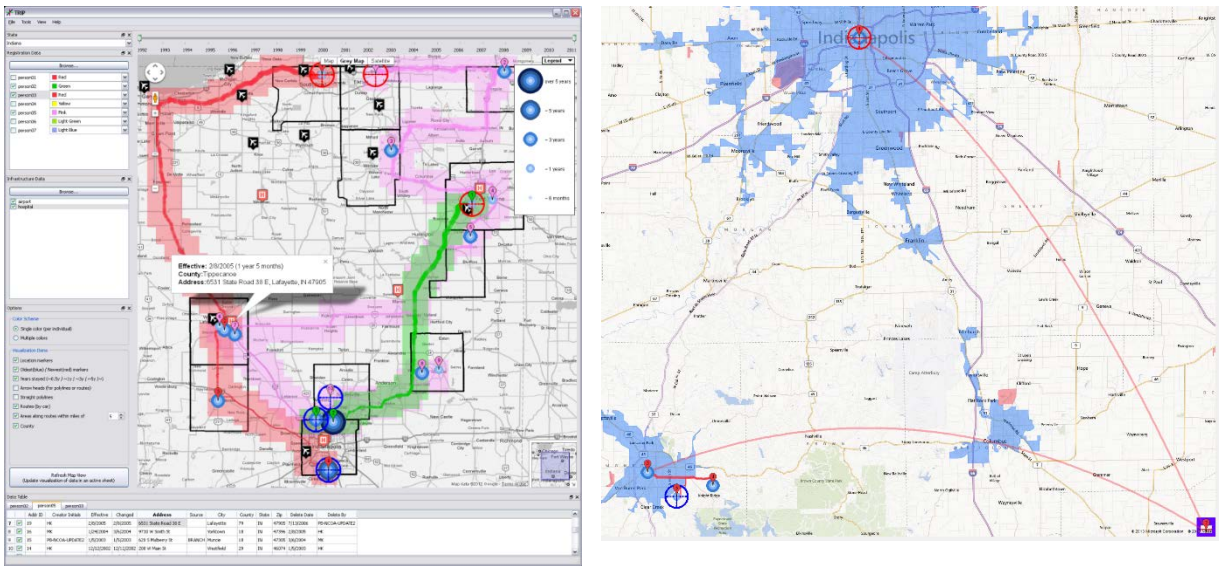
- *Geocoding through secure socket layer*
- *Driving route of movement locations*
- *Reachable areas along driving routes*
- *Various visualization items*
- *Correlation between infrastructure and individual movements*

Partners:

- *Indiana Intelligence Fusion Center*

Mission Need

As individual movements could have correlations with social and/or geo-spatial factors, it is critical to understand the spatiotemporal patterns of individual movement behavior. Given the incomplete, complex, and context dependent information, a human in their analysis and decision-making loop is crucial. Therefore, a visual analytics approach offers great potential through interactive and scalable techniques, helping analysts to extract, isolate, and examine the results interactively. TRIP allows an analyst to explore and examine spatiotemporal correlation among individual movements and between infrastructures, such as airports and schools. Given individual movement history, various spatial and temporal cues are visualized. As geo-spatial cues, location markers including newest/oldest indicators, driving routes, reachable areas along the routes and county boundaries are overlaid on the map. The routes and reachable areas are also used to present possible relationships and shared areas among individual movements and the movements and infrastructures. As temporal cues, each location is numbered in temporal order. The Route line connecting locations changes its thickness to show that an individual moved towards the direction increasing the thickness. Furthermore, the duration of stay at each location is highlighted using ring-shaped glyphs. TRIP supports various types of address data and also international addresses. The trajectories between the international and the domestic addresses are visualized with curve lines.



Multiple individuals' movement histories visualized on the map with various spatial and temporal cues (Left). Visualization of airport(red color), urban area (blue color), and an international address (Right).

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- *US Department of Homeland Security*

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Flight Delay Data Exploration System for Analyzing Spatiotemporal Multivariate Data

Benefit: *Our system provides users from government agencies (e.g., TSA, FAA) to the general public with a suite of tools that enables the spatiotemporal exploration of multivariate flight delay records. This suite of tools also enables the analysis of flight delay patterns and trends as well as provides forecasts of delays based on a given time and location using historical data.*

Data Layers:
- *Flight delay records*
- *TSA records*
- *Airports*

Collaborators:
- *TSA*

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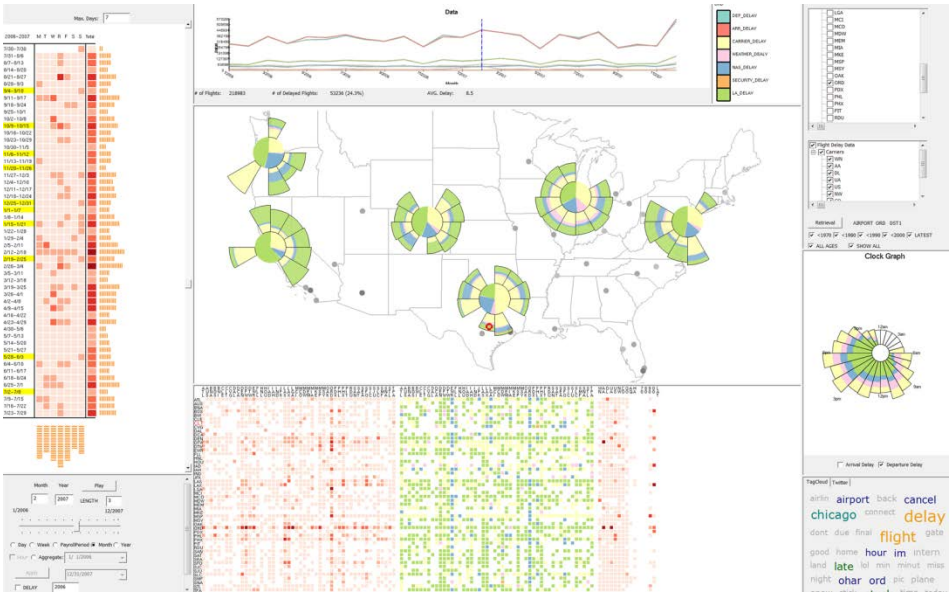
Mission Need

Complex data with combinations of these characteristics: temporal, spatial, network-based, and multi-variate makes analysis more difficult. Example data sets showing such complexity include data from transportation, shipping, and logistics industries that have many connected operational places (e.g., origin and destination pairs) with multiple variables describing the operations in the places based on time, transactions, or incidents. In this work, we focus a visual analytics system that enables effective analysis through a suite of linked views that include networked geographical map, pixel-oriented network matrices, calendar, and clock views. In addition, we have designed new visual representations, Petal and Threads, to provide features of multiple variables among operational locations with minimized visual clutter.



Our system consists of multiple coordinated and linked views: Calendar view, Filters for selecting times (for aggregation), airports, airlines, and ages of airplanes, Line graph and correlation view, Legend view for displaying types of delays, Geographical view, Pixel view, Clock view, Twitter tag cloud view.

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vaccine@purdue.edu
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The Uncertainty of Identity

Benefit: *The goal of this work is to both analyze and create data that allow the creation of cybergeodemographics and their integration with geodemographic profiles of the physical embodiment of social systems. Our view is that online and conventional profiles need to be developed hand in hand, since all social interactions also take place in a physical setting, and it is simply makes no sense to consider one in isolation of the other.*

Collaborators:

- *Purdue University*
- *University College of London*
- *Birmingham University*
- *City College of London*

Funded by:

- *US Department of Homeland Security*
- *Engineering and Physical Sciences Research Council*

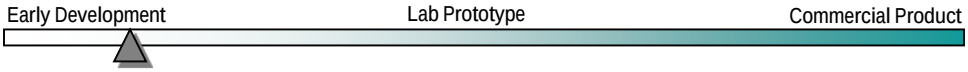
Institution Contact:

- *Ross Maciejewski (rmacieje@asu.edu)*
- *Arizona State University*
- *http://vader.lab.asu.edu*

Mission Need

This is an interdisciplinary project from Computer Science (St. Andrews), Engineering (City University) and Geography (UCL), in partnership with experts in Visual Analytics at Arizona State University and Purdue University in the United States. Our goal is to link information pertaining to real and virtual worlds in order to better manage the uncertainties inherent in establishing human identity. Our basic premise is that uncertainty in identifying and characterising individuals may be managed and understood by: (a) exploring and analysing spatio-temporal profiles of lifestyles and activity patterns; (b) concatenating and conflating detailed but under-exploited datasets in the virtual and real domains; and, more speculatively (c) seeking and analysing crowd sourced volunteered data that link physical and virtual identities. Through these actions it will be possible to improve our ability to characterize and validate an individual's identity, to devise improved profiles of individuals and groups that bridge the real and virtual domains, and to document and manage the uncertainties inherent in these tasks. Representative social network data are notoriously difficult to assemble, manage and analyze, and there are important ethical issues concerning their use. What we have done is begun developing incentivized social network tools to install on users' Facebook accounts and that will profile each of their contacts using statistics arising from their names and geographic residence. The innovation here is that the application will harvest names based indicators of ethnicity, age and socio-economic status, alongside approximate geographic coordinates of residence. In exchange for this, respondents will receive reports that characterize their own social networks (along with assurances that individual reports will not be shared with third parties and will only be used in aggregate in the research). Analyzed in conjunction with geodemographic profiling, the result may be the first representative linkage of virtual and real communities in time and (international) space.

Exploring the geodemographic profile between internet searches for surnames and their expected geographic locations.



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VALET – Visual Analytics Law Enforcement Toolkit

Benefit: *Our VALET technology provides law enforcement agencies with a suite of tools that increase situational awareness and enable the spatiotemporal exploration of multivariate data sets and police records. These tools provide advanced analytic capabilities that allow officers to develop and test hypotheses about law enforcement activities within various areas of their communities.*

Mission Need

Analyzing high volume criminal, traffic and civil (CTC) incident data is a crucial component for preventing crimes and judiciously allocating resources for the law enforcement community. However, with data sets increasing in size and complexity, and as budgets shrink and departments scale back, the ability of local law enforcement agencies to effectively analyze the data being collected becomes increasingly strained. As such, we have developed a visual analytics toolkit for enhanced exploration and analysis of multivariate spatiotemporal law enforcement data to enable advanced data exploration and analysis of CTC incidence reports. The VALET technology incorporates both intelligence led policing and community-based policing methods that enable law enforcement agencies to assess and mitigate risks due to criminal activities in their areas of responsibility.

Data Layers:
- *Criminal, Traffic, Civil*
- *Calendar Events*
- *Weather*
- *Census & Demographic*
- *GIS*
- *Moon Phase*

Collaborators:
- *Purdue University*
- *Arizona State University*
- *Purdue Police*
- *West Lafayette Police*
- *Lafayette Police*
- *Tippecanoe County Sheriff*
- *Indianapolis Police*
- *NYPD*
- *Ohio State Highway Patrol*
- *Evansville Police*

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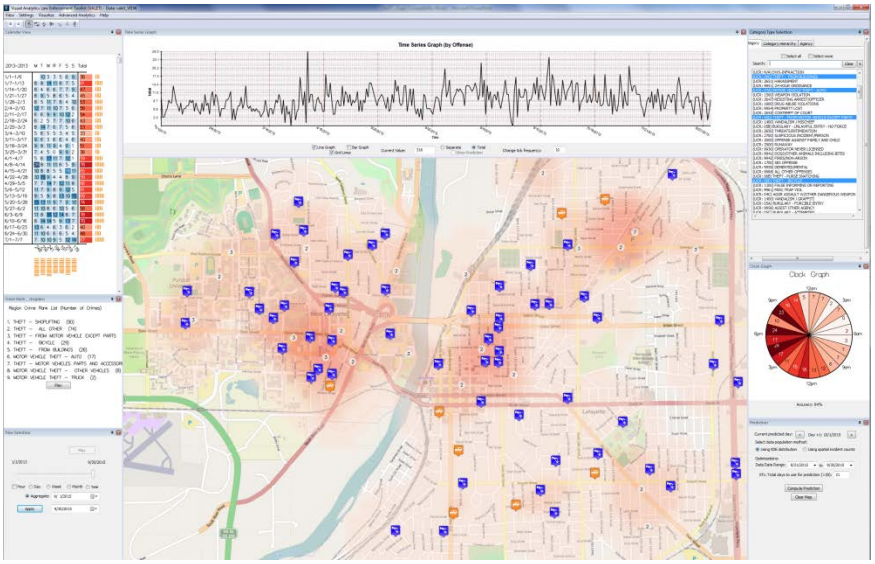
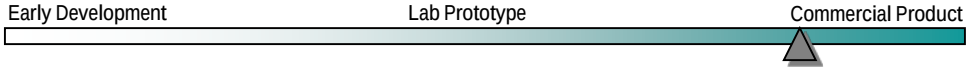


The Visual Analytics Law Enforcement Toolkit where the user is exploring crimes against person incident reports for Tippecanoe County, IN. Linked views show the line graph (top), calendar view (top-left) and clock view (middle-right) temporal plots. An interactive menu showing the CTC offenses is shown on the top-right. A crime forecasting panel (bottom-right) provides users with the ability to predict future crime levels. The middle-left view shows the trending view that provides a quick way to ascertain the offenses, names, and locations that are trending for a given region and date range. A time slider that ties all linked views together is shown on the bottom-left.



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VASA: Visual Analytics for Security Applications

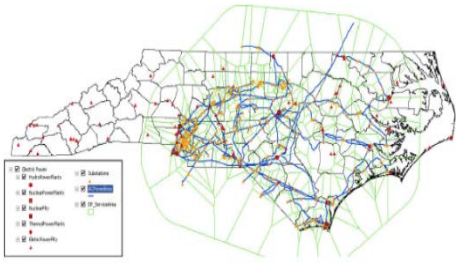
Benefit: *This system provides a visual analysis and decision making environment for severe weather and natural disaster planning and response for several critical infrastructures (e.g., power, computer networks, food distribution). Business officials and local officials can use this tool to evaluate continuity of operation plans, plan for contingencies, prepare for, and respond to a severe weather event or natural disaster. rerouting suggestions for food distribution centers impacted by a hurricane to facilitate decision-making in emergency situations.*

Data Layers:

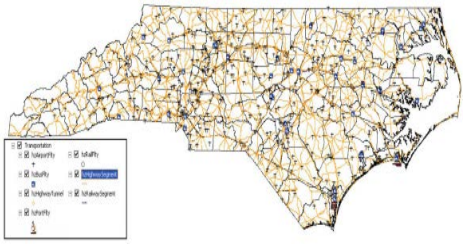
- *Infrastructure geolocations*
- *Distribution routes*
- *Economic and business models*
- *Weather event data*

Collaborators:

- *Purdue University (lead)*
- *Texas Advanced Computing Center*
- *University of Minnesota*
- *University of North Carolina at Charlotte*



<Power Transmission Grid for Simulation>



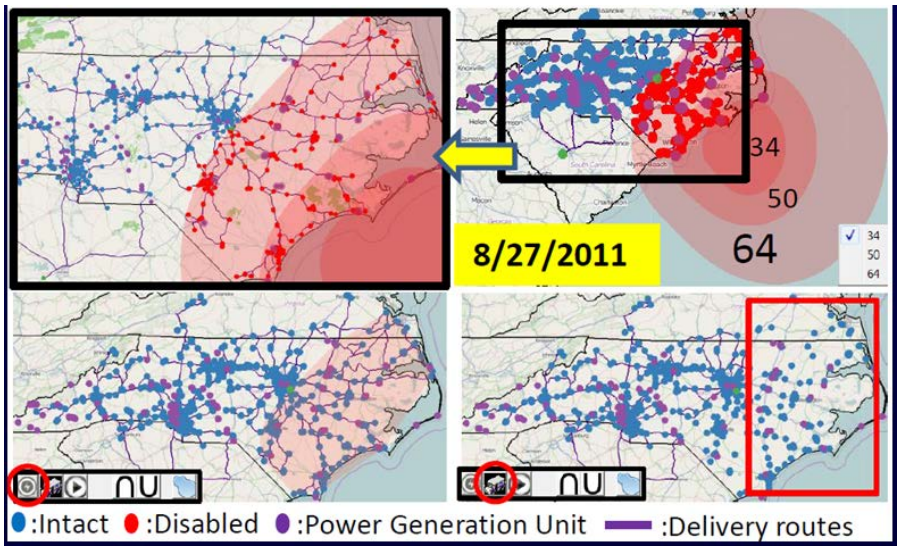
<Transportation Network for Simulation>

Mission Need

Effective analysis for emergency situations caused by severe weather conditions and natural disasters requires understanding of a comprehensive set of data, including weather, critical infrastructures, and transportation network logistics. However, both civic and business analysts often encounter difficulty in estimating the impact of an event, forecasting damage, and discovering optimal solutions from various resources due to incomplete sets of data, lack of reliable simulation models, and no existing environments for decision-making. We are designing and developing a visual analytics system that provides this environment for analysts and decision-makers.

In order to provide awareness of current and forecasted impact caused by the natural events, our system presents historical and simulated events (e.g., hurricanes, tornadoes, blizzards) where users can instantly consider various scenarios, alternative and operational and simulation attributes. Based on these decisions and parameters, new simulations may be run to explore the effects on multiple critical infrastructures (e.g., power, computer networks, water, transportation, sewer) and the effectiveness of contingency plans and mitigation strategies.

One example is a franchise food network where food delivery routes need to be changed based on store and infrastructure damage. In our visual analytics environment, analysts and decision-makers can effectively monitor the situation, understand the impact of these storms on critical infrastructure, and evaluate potential re-routed road paths for the food network with adjusted parameters.



Visualization of stores in North Carolina damaged by Hurricane Irene (August 2011).

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