BioPortal: An Integrated Infectious Disease Information Sharing and Analysis Environment

Daniel Zeng, Hsinchun Chen, Chunju Tseng, Catherine A. Larson
Dept. of MIS.
University of Arizona,
Tucson, Arizona
{Zeng,hchen,chun-ju,cal}@eller.arizona.edu

Millicent Eidson, Ivan Gotham
New York State Department of Health
University of Albany
{mxe04,ijg01}@health.state.ny.us

Cecil Lynch
California Department of Health Services
University of California, Davis
clynch@dhs.ca.gov

Michael Ascher
Lawrence Livermore National Laboratory
ascher1@llnl.gov

ABSTRACT
We present the BioPortal system, an integrated cross-jurisdictional data sharing and analysis environment to facilitate detection, prevention, and management of infectious disease outbreaks.

Categories and Subject Descriptors
H.4.2 [**INFORMATION SYSTEMS APPLICATIONS**]

General Terms
Management; Design; Security.

Keywords
Infectious disease; bioterrorism response; public health

1. PROJECT BACKGROUND
Information systems play a central role in developing a comprehensive approach to prevent, detect, respond to, and manage infectious disease outbreaks of plants, animals, and humans. Funded by the National Science Foundation through its Digital Government and Information Technology Research programs with support from the Intelligence Technology Innovation Center, we have been developing scalable technologies and related standards and protocols, implemented in the BioPortal system, to deal with data sharing and analysis challenges arising in the field of infectious disease informatics. In the first phase of this project (September 2003—June 2004), we completed a research prototype providing an integrated information sharing and data analysis environment across jurisdictions for two prominent infectious diseases—West Nile Virus (WNV) and Botulism. In the second phase of the project, started in July, 2004, our research effort has been aiming at expanding BioPortal disease dataset coverage to include diseases such as Foot-and-Mouth Disease (FMD) and Chronic Wasting Disease (CWD). We have also integrated test data collected from the BioWatch system, an air pathogen sensing system developed to detect airborne hazard. In addition, we have been actively developing advanced spatio-temporal data visualization and analysis capabilities. Such capabilities have important applications in infectious disease outbreak detection and can provide critical information to facilitate disease outbreak management and response.

dg.o 2005, May 15 - 18, 2005 Atlanta, Georgia, USA

2. BIOPORTAL SYSTEM OVERVIEW
From a systems perspective, BioPortal is loosely-coupled with the state health information systems in that the state systems will transmit disease information through secured links to the portal system using the Public Health Information Network Messaging System (PHINMS) or other similar systems based on XML and HL7. Such information, in turn, is normalized and stored in the internal data store maintained by BioPortal. The data store is used to support various query, reporting, analysis, and visualization functions. Figure 1 illustrates the main components of the system and shows the main data flows between them and the underlying data sources.

3. DEMO PLAN
We plan to demonstrate several complete BioPortal use case scenarios to illustrate the Web-enabled process of accessing, querying, and analyzing infectious disease datasets collected from distributed sources. These scenarios will include FMD and BioWatch datasets. We also plan to demonstrate the BioPortal's spatio-temporal data analysis and visualization capabilities using the real-world datasets. These capabilities are implemented through two modules of BioPortal: (a) a hotspot analysis module that implements existing methods (e.g., scan statistics-based methods) that can detect "unusual" spatial and temporal clusters of events as well as several new methods using Machine Learning techniques, and (b) a visualization tool called Spatial-Temporal Visualizer (STV), which can help the user effectively explore spatial and temporal patterns through an integrated set of tools including a GIS tool, a timeline tool, and a periodic pattern tool.

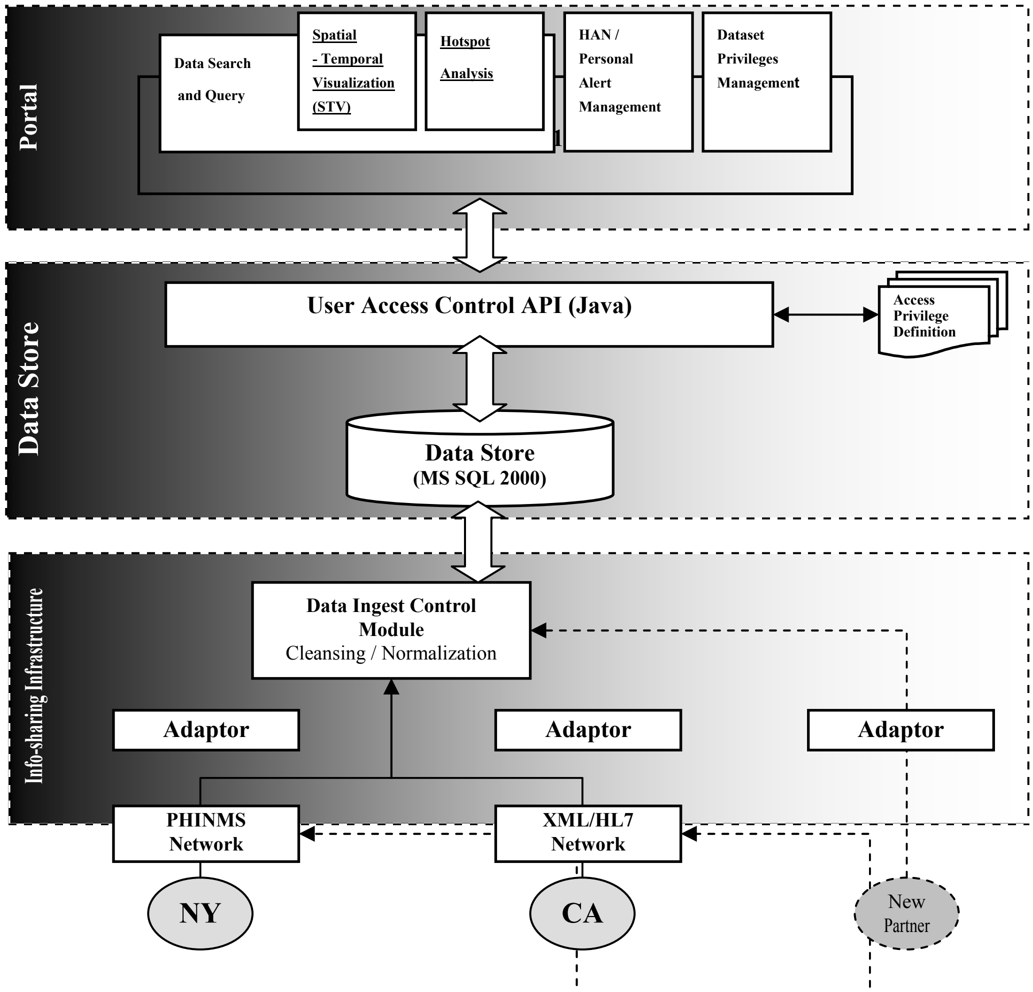

Figure 1. BioPortal System Overview

ACKNOWLEDGEMENTS

Reported research has been supported in part by the NSF through Digital Government Grant #EIA-9983304 and Information Technology Research Grant #IIS-0428241.