

BIRS – Bioterrorism Information Retrieval System

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Abstract:

Bioterrorism is the intended use of pathogenic strains of microbes to widen terror in a population. There is a definite need to promote research for development of vaccines, therapeutics and diagnostic methods as a part of preparedness to any bioterror attack in the future. BIRS is an open-access database of collective information on the organisms related to bioterrorism. The architecture of database utilizes the current open-source technology viz PHP ver 5.3.19, MySQL and IIS server under windows platform for database designing. Database stores information on literature, generic- information and unique pathways of about 10 microorganisms involved in bioterrorism. This may serve as a collective repository to accelerate the drug discovery and vaccines designing process against such bioterrorist agents (microbes). The available data has been validated from various online resources and literature mining in order to provide the user with a comprehensive information system.

Availability: The database is freely available at <http://www.bioterrorism.biowaves.org>

Keywords: Bioterrorism, unique metabolic pathway, KEGG database, protein, bioterrorism agents.

Background:

Bioterrorism is one of the biggest threats that human life faces today [1]. In definition, a bioterrorism attack is the deliberate release of viruses, bacteria, or other germs (agents) used to cause illness or death in people, animals, or plants [2, 3]. Bioterrorism poses a global threat to life and well being of the people [4] and therefore there is a definite need to promote research in the field of biodefense for development of vaccines, therapeutics and diagnostic methods as a part of preparedness to any such bioterror attack in the future. Organisms including bacterial species such as *Bacillus anthracis*, *Yersinia pestis*, viral species such as *Ebola*, *Variola*, *Hendra*, and few microbe toxins have been reported as agents of Bioterrorism [4-8]. Currently several parallel databases/resources viz. Centre for Disease Control and Prevention (CDC), Pubmed, KEGG, and Sherlock Microbial Identification System (MIS) [9] are available for studying the prevention and diagnostic of bioterror agents but most of them have been realized to be segregated in terms of

information or have a limited access. Similarly, CHEMM [10], another online resource that provides information related to emergency preparedness for multiple conditions/events. The dataset is very huge related to conditions and not limited to bioterrorism while CDC, provides online information related to different disease conditions and is quit general. To address above issues, we have developed an open access repository named BIRS-Bioterrorism Information Retrieval System, which is non-redundant, free-access and normalized for comprehensive information on biological weapons and toxins. The database is important for researchers in the pharma industry to develop rapid diagnostics and designing drugs/vaccine molecule against such organisms.

Methodology:

Data Collection

Generic information about the biological agents was collected from Centre for Disease Control and Prevention [11] and literature mining. Unique metabolic pathway information was

collected from KEGG database [12] and the literature was collected and compiled from Pubmed. The records are organized in alphabetical order to simplify the task of finding

scientific data related to the organisms involved in the spread of bioterrorism. A detailed flowchart of data collection can be seen in (Figure 1).

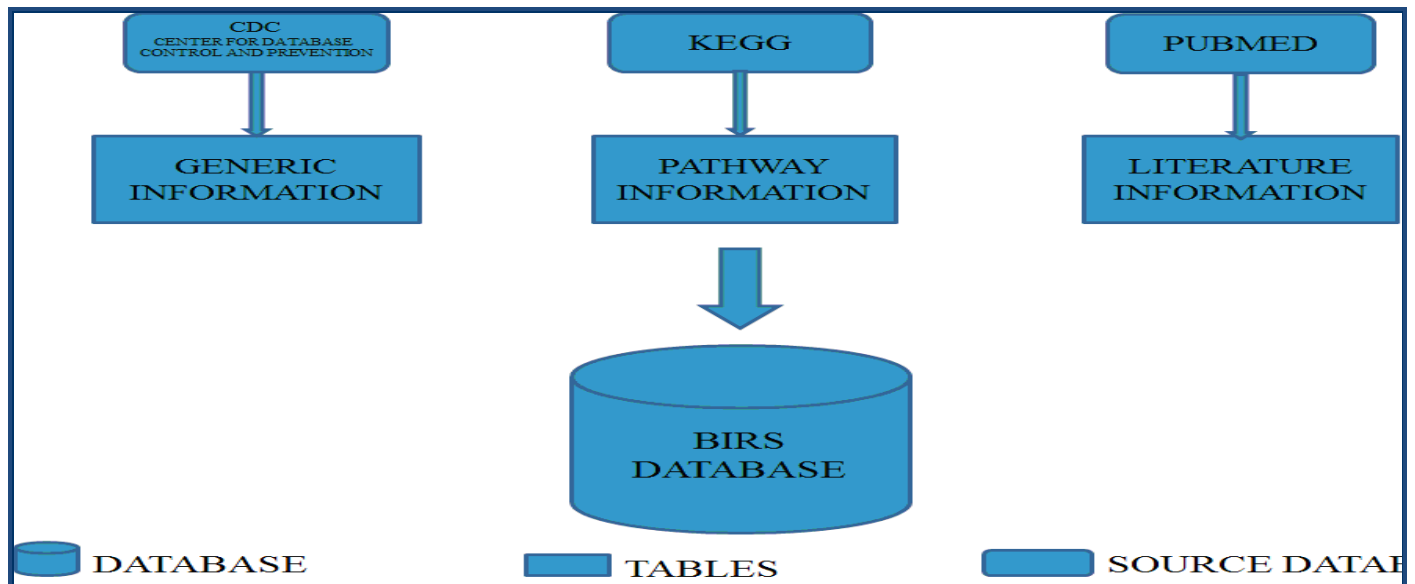


Figure 1: Data Collection Flowchart

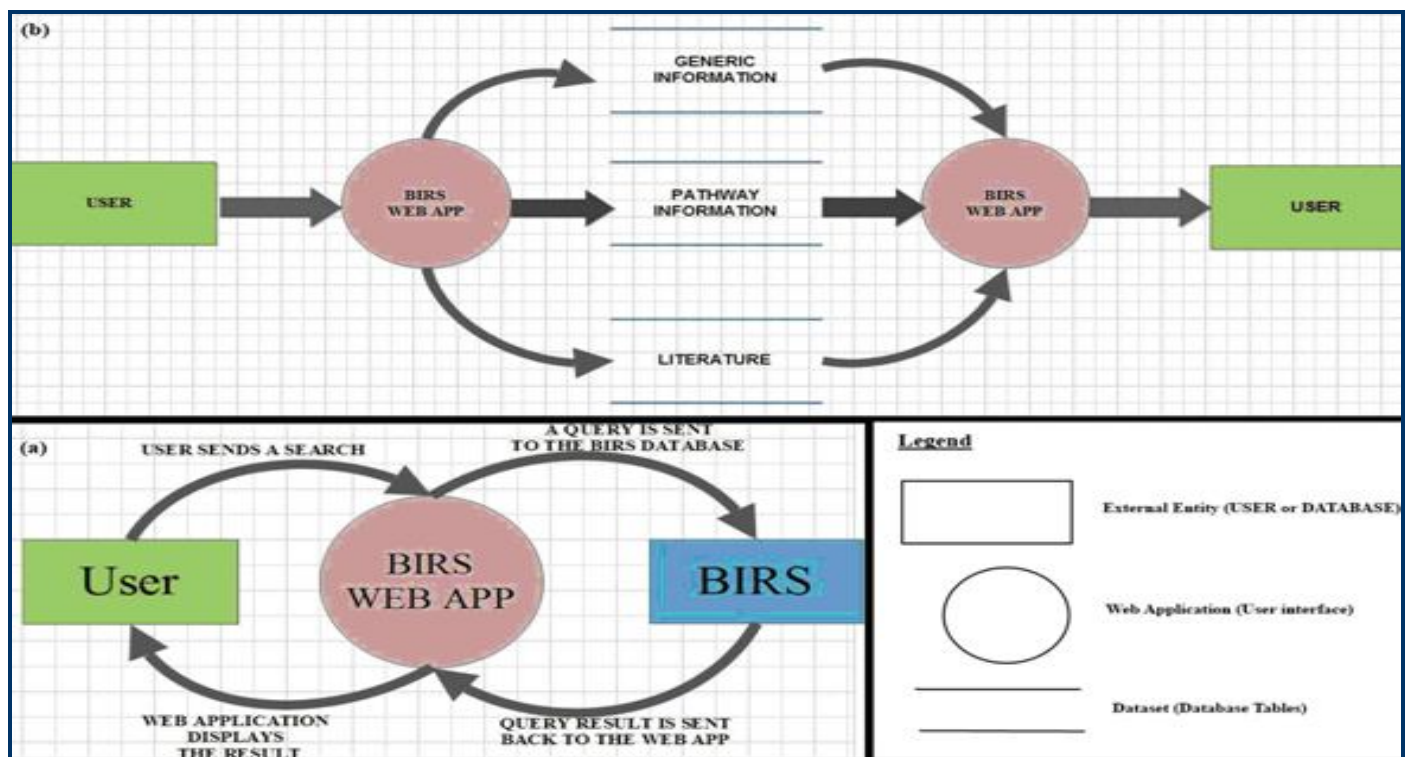


Figure 2: a) Data Flow Diagram LEVEL-0; b) Data Flow Diagram LEVEL - 1

Architecture and Design of BIRS

BIRS has been developed with MySQL client version 5.0.51 as back-end and PHP 5.3.19 as the front end. The database has been developed and compiled using RDBMS technology with a user friendly interface that presents a non-redundant, high performance data repository. While designing BIRS we cared for normalization, to eliminate data redundancy and build a consistent database. The database is comprised of three tables viz. Generic-Information, Pathways, Literature and follow

architecture of a relational database. The database can be accessed by (i) browsing through the web interface (Figure 2a), (ii) simply searching using the search functionality (Figure 2b). Advanced search options are also available for precise retrieval of information.

Data Flow Information

The data flow occurs in two levels that is shown by the flow diagrams: **Level 0**: The user sends a query on the web

application and from the application the query is transferred to the database, after processing the query, the database returns the adequate information back to the web application, which is visible to the user in form of a table (**Figure 3a**); **Level 1:** The user sends a query on the web application and from the application the query is transferred to the different tables of the database like generic information, pathway information etc. query then gets processed at the server and the relevant information is returned to the web application in form of a table for the user to see (**Figure 3b**).

Utility:

BIRS would serve as an open-access repository that enlists organisms having the potential to be used as an agent of bioterrorism. The database finds utility to the scientific

community for a quick review on literature, metabolic pathways, and generic information about these organisms. Further, it may also find application in the discovery of potential drug targets to control bioterrorism. This repository could also be useful for veterinarians to access existing information on the most-deadly animal and human diseases that could possibly damage or wipe out the livestock industry. BIRS uses Wordpress 3.5 as its content management system, to provide the end-users with a better user interface and advanced widgets for intuitive browsing and searching experience.

Caveats:

BIRS does not include enzyme and protein information of the organisms, as the data on bioterror agents was scarce.

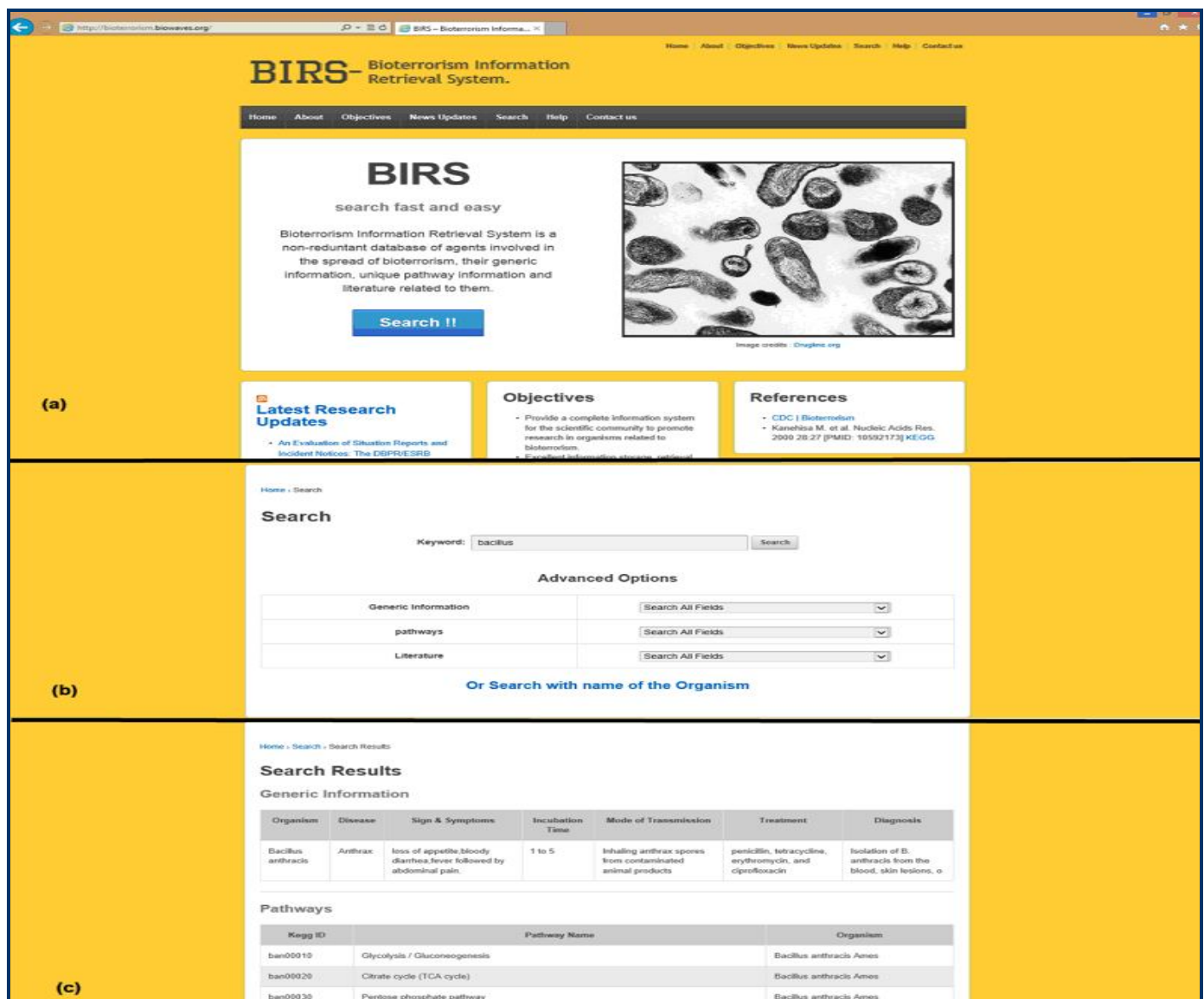


Figure 3: Snapshot of BIRS Web Application (a) Homepage for BIRS; (b) Search page for BIRS; (c) Search results page for BIRS.

Future development:

As and when in future, more information such as enzymes and proteins related to the organisms will be added and the database would be further refined and updated with links to new bioterror agents.

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