Design and Implementation of Distributed WebGIS Architecture

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WebGIS

• GIS is a powerful set of tools for collecting, storing, retrieving, managing, analyzing and displaying spatial data.

• Users can combine data and information accessed over the Intranet or Internet with the local data for display, query and analysis.

• Internet allows all levels of society to access geo-spatial information and provides a media for processing geo-related information with no location restrictions.

• Web GIS is a mechanism to deliver maps and GIS services on the internet.
WebGIS

- WebGIS is a viable tool for building various geospatial Web application.

- Traditionally, in WebGIS all the geographic data was stored on a single server i.e. it uses a centralized paradigm approach.

- WebGIS is a cost effective, easy and efficient way to access and disseminate the geographic information, spatial analysis tools and geospatial web services.

- Web-based GIS is evolved from different web maps and can be modeled as client-server architecture.
  - This can be thin client architecture
  - This can be thick client architecture
Thin Client Architecture

• Thin client server approach has following advantages:-
  a) Central Control
  b) Easy for data version
  c) Generally cheaper
  d) Integration possibilities
  e) Regarding some cartographic aspects such font.

• Thin client server approach has following disadvantages:-
  a) Large data volume,
  b) Slow response time,
  c) Less interactive, and
  d) No local accountability.
Thick Client Architecture

- Thick client server approach has following advantages:-
  a) Document/graphics standards are not required.
  b) Vector data can be used.
  c) Image quality not restricted to GIF and JPEG.
  d) Modern interface is possible;
     it is not restricted to single - click operations.

- Thick client server approach has following disadvantages:-
  a) Additional software requirement, and
  b) Platform/ browser incompatibility.
Distributed WebGIS

- Distributed WebGIS provides an efficient way to share data worldwide on the Internet.

- Distributed Web GIS architecture is modular and allows the publishing of web service descriptions.

- Distributed GIS service model is that a client program, in either an browser or an independent application, able to access the distributed resources in the entire network.

- Client connect to the several servers if needed and a specific machine may be the client at one time and the server at another time.

- Ideal distributed GIS service model is “Geodata anywhere, Geoprocessing anywhere”.
Service Oriented Architecture for WebGIS

- SOA can be used to implement the Distributed WebGIS Architecture.

- SOA in improving the efficacy of traditional client server model by building distributed, dynamic service system to meet service requirement of different user.

- Provide three type of different services. These are a) Data Service, b) Processing Service and c) Registry Service.
SOA for WebGIS

Data Services:
- a) It is a service which is tightly coupled with specific data
- b) Web Feature Service (WFS), Web Mapping Service (WMS) and Web Coverage Service (WCS) comes in this group.

• Processing Services:
  - a) These type of services provide operation as determine by user-specific parameter.
  - b) Provide function such as coordinate projection, rasterization and vectorization.

• Registry Services:
  - a) These type of service help user to classify, describe and search information about Web Services.
Objective of Present Work

• To design and develop distributed WebGIS Architecture using OGC standards.

• The Allahabad city of U.P., India has been taken as a study area.

• A prototype distributed WebGIS is developed using two applications domains, namely, transportation network and water supply system of Allahabad city.
Open Source Technology

- Open source program allow users to modify source code according to their requirement.
- Provides better interoperability.
- Open Geospatial Consortium, (OGC) is an international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services.

The OGC Standards for GIS

OGC Web Services

- Web Registry Services (WRS)
  - Register Services
- Web Map Services (WMS)
  - Get Map
  - Get Feature Info
- Web Feature Services (WFS)
  - Get Features
  - Transaction WFS
- Web Coverage Services (WCS)
  - Get Coverage

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Open Source Resources Used

• GeoServer is used as an open source software in the present study.

• ILWIS, an open GIS software is used to create integrated geospatial database.

• GeoServer and Apache Tomcat are integrated for imparting geospatial web capabilities with respect to WMS and WFS.

• MySQL is used for storing of security aspects and non-spatial data for decision making.

• PHP: Hypertext Pre-processor language has been used for dynamic server side scripting.
Integrating Web Services in GIS

- OGC web services provide a framework for Web based discovery, access, integration and analysis of online geospatial data sources.

- Web Feature Service (WFS) and Web Map Service (WMS) are the two important OGC standard used in this study.

  a) Web Feature Service
  - It allows a client to retrieve geospatial data from multiple servers.
  - It supports operations like Insert, Update, Delete, Query on geographic feature using HTTP.

  b) Web Map Service
  - It displays maps in standard image format such as Scalable Vector Graphics (SVG), Portable Network Graphics etc.
Methodology Adopted

Geospatial Database (Using ILWIS)

- Storing of Geospatial data
- Non-spatial data

GeoServer, Apache Tomcat, MySQL & PHP

WMS

Slave Server

WFS

Utility Service

GeoServer, Apache Tomcat, MySQL & PHP

Slave Server

WFS

Utility Service

GeoServer, Apache Tomcat, MySQL & PHP

Master Server

WFS

Utility Service

Slave Server

WMS

Client 1

Client 2

...........

Client N

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Different servers have been taken which will act as slave server and consists of the geospatial data and non-spatial data.

- A Master server is used for sharing of the geospatial data and non-spatial data and publishing of map on the web.

For example:
- IP address of the slave server is 172.31.10.62 and 172.31.10.76
- IP address of the master server is 172.31.10.67.
- Distributed WebGIS services will be accessed by the client using: [http://172.31.10.67/DS_WebGIS](http://172.31.10.67/DS_WebGIS)
Methodology Adopted...

- In the first slave server, the geospatial data and non-spatial data of the Road Network of the Allahabad City is put.

- In another slave server, the geospatial data and non-spatial data of the Water Supply System of the Allahabad City is put.

- From the master server, the geospatial data and non-spatial data of the Road Network and Water Supply System of the Allahabad City is accessed simultaneously.

- There would be no effect on the system if any of the slave servers is shut down.
Distributed WebGIS: Prototype Development

- The prototype developed is based on Jacobson’s method of Object Oriented Software Engineering.

- The process model for development of Distributed WebGIS framework:

  - The incremental development strategy allows the problem to be tackled in smaller or in manageable portions.
The developed prototype has been associated with three users. These are:

a) Administrator user,

b) General user and

c) Developer.

• The design phase involve the creation of geospatial water supply and road network database.

• The spatial and non spatial data of the water supply are put in one server and road network server on another.
Distributed WebGIS: Complete Framework

- Module I: describes the detailed process to register the user for authentication. After registration process, user can use the WebGIS with full phase operation.

- Module II: detailed viewing of Allahabad City associated with Road Network and related data files.

- Module III: detailed viewing associated with Road Network of Allahabad city and related data files.

- Module IV: describes utility services i.e., user level for security aspects, and uploading/ downloading features

- This prototype Distributed WebGIS has been implemented at MNNIT Intranet level.
Visualization of Distributed WebGIS

Map Page
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Visualization of Distributed WebGIS...
Visualization of Distributed WebGIS...
Visualization of Distributed WebGIS...
Concluding Remarks

- The present research work uses OGC standards for creating, accessing, integrating and sharing the geospatial information on the web by adopting a new approach to develop a robust distributed WebGIS architecture.

- A distributed architecture is developed so as to improve the efficacy of traditional thin/thick client server architecture.

- This architecture provide an efficient mechanism for generating and delivery of value added geospatial information.

- The developed architecture adopts a modular and flexible structure.
Concluding Remarks ...

• It provides a mechanism for the generation and delivery of geospatial information by extending the concept of web services in the field of GIS.

• The developed prototype distributed WebGIS is operational at MNNIT intranet level which will be put on Internet soon.

• The further refinement of the model provided by making the existing database more comprehensive and adding more features such as video-conferencing, chat room and 3D view.
Thank You