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Real Time Distributed Geographical Information System (DGIS) Tool for Recording, Updating and Analysing the Health Related Data Using Open Source Technologies

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Abstract

Traditionally, the method of disease record keeping system and management is carried out manually with the combination of simple database management system. But the developments in the field of computer science are directly influenced the Geospatial technologies. Starting from the traditional mainframe Geographical Information Systems to the latest Distributed Geographical Information Systems (DGIS) the Information Computing Technology (ICT) has directly helped to benefit the Geospatial services to the common man. DGIS has become an expert technology for geospatial data communication due to distributing technology of the web servers.

This paper presents a DGIS application for recording, updating, and modifying the health related data for different diseases of Uttarakhand state using Internet GIS technology. This application tool has been built with Open source integrated technologies right from the database to Internet GIS application tool.

Introduction

The paper aims for the development and implementation of web-based real-time geographical information system to provide the decision makers with a tool to manage, subsequently analyse and to exchange information for effective monitoring of various diseases. In this way one can monitor in real-time on the map the state of time-evolving diseases in Dehradun (Uttarakhand).

Internet today has become a viable means for disseminating information anywhere on the globe in fraction of seconds and above all reaching incredible number of potential people at same time. The present system is both economical and simple for users as with only elementary computer knowledge they can access the data shared by WEBGIS and using only the pre-established hardware and software setup to connect to the Internet for accessing the application.

Methodology

The system is designed using a 3 tier architecture (Figure 1) consisting of a Client tier (Web browser), an Application tier built on Open Source UMN Mapserver [1], Apache [2] and PHP [3], and a Database tier running on spatially enabled PostgreSQL [4]

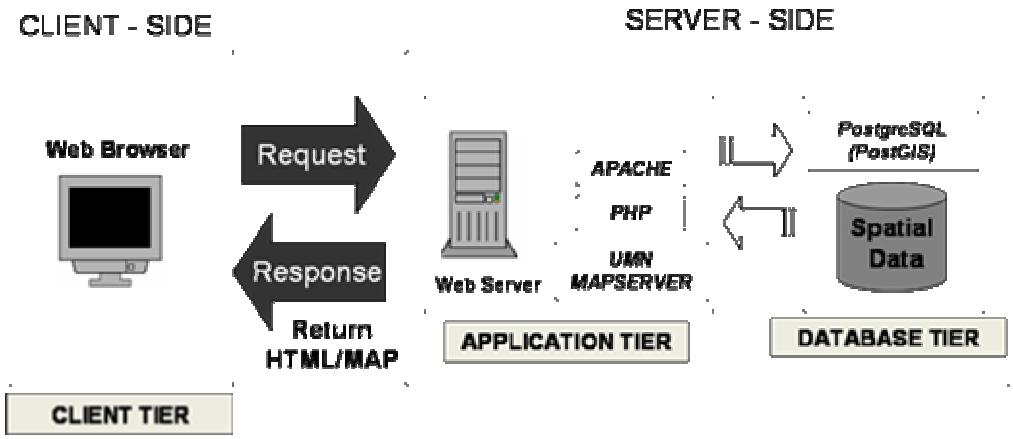

Figure 1: System Architecture

The client-tier gets input from the user and displays the final output. It consists of the Maps (in JPEG format), pie-chart with embedded JavaScript and HTML. The system is cross-browser so user can use any browse may be IE, Mozilla Firefox, Netscape Navigator etc to access the system. The application tier consists of Apache Web Server, UMN mapserver with the web scripting language PHP. It interfaces between the database tier and client tier. MapServer [1] is an Open Source platform for publishing spatial data and interactive mapping applications to the web. Originally developed in the mid-1990's at the University of Minnesota, MapServer is released under an MIT-style license, and runs on all major platforms (Windows, Linux, Mac OS X). The Mapserver system supports Mapscripts [5] which provides a scripting interface for MapServer for the construction of Web and stand-alone applications. MapScript can be used independently of CGI MapServer, and it is a loadable module that adds MapServer capability to your favourite scripting language. MapScript currently exists in PHP, Perl, Python, Ruby, Tcl, Java, and .NET flavours.

The system is developed using MapServer for Windows - MS4W [6], the no fuss installer for setting up MapServer on Microsoft Windows platforms. The basic MS4W package installs a pre-configured webserver environment that includes the following components [6]:

- Apache HTTP Server version 2.2.11
- PHP version 5.3.0
- MapServer CGI 5.4.2
- MapScript 5.4.2 (CSharp, Java, PHP, Python)
- Includes support for Oracle 11g, and SDE data
- MrSID support built-in
- GDAL/OGR 1.6.1 and Utilities
- MapServer Utilities
- PROJ Utilities
- Shapelib Utilities
- Shp2tile Utility
- Shpdiff Utility
- AVCE00 Utilities
- OGR/PHP Extension 1.0.0
- OWTChart 1.2.0

The customised GMap75 PHP/MapScript Sample Application [7] is used as front-end along with OWTChart [8] utility that comes bundled with MS4W for representing health data in Pie Chart format to the end user.

The database tier consists of object-oriented relational database management system (PostgreSQL) with PostGIS support to allow for storing and manipulating spatial data. PostGIS [9] adds support for geographic objects to the PostgreSQL object-relational database. In effect, PostGIS "spatially enables" the PostgreSQL server, allowing it to be used as a backend spatial database for geographic information systems (GIS), much like ESRI's

SDE or Oracle's Spatial extension. The spatial data consists of Dehradun district and wards boundaries along with roads and hospital layers. The above data is stored in PostgreSQL database through the help of SPIT (Shapefile to PostgreSQL/PostGIS Import Tool) plug-in of Open Source Quantum GIS [10].The database structure is given in figure 2.

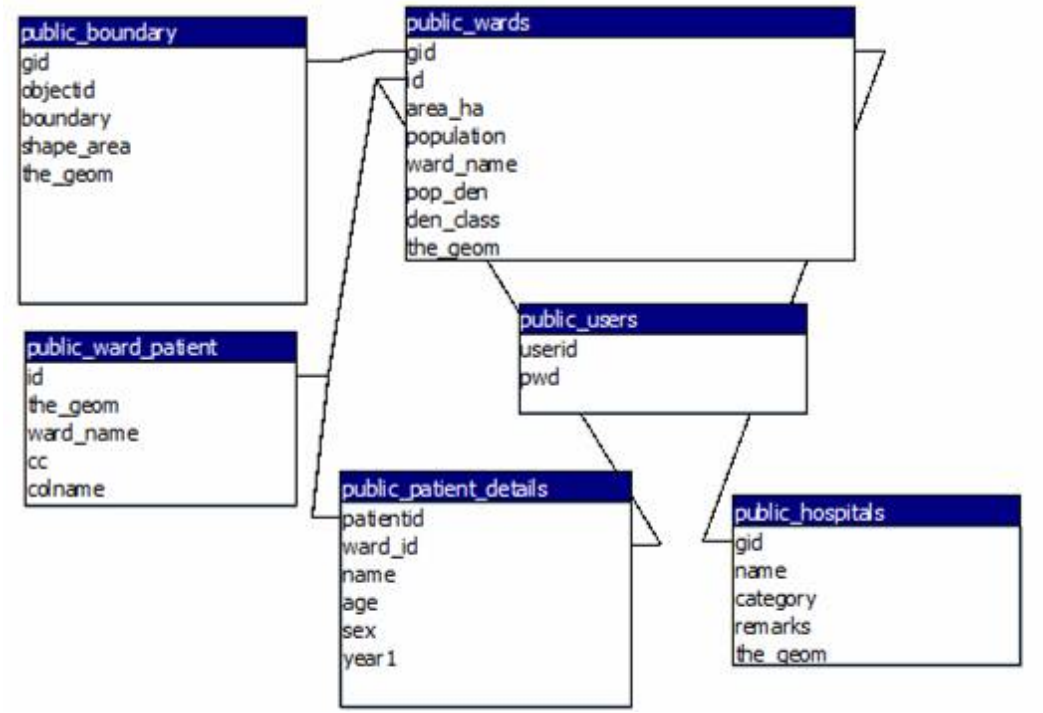

Figure 2: Database Structure

The system includes two main sections namely the WEBGIS interface (accessible to all) and an administrative panel (accessible only to authorised users) for adding/updating health related data. The WEBGIS interface (Figure 3) includes the standard thematic map of Dehradun ward along with standard browsing functions (zoom in, zoom out, pan) and query function to show the data related to disease in various wards.

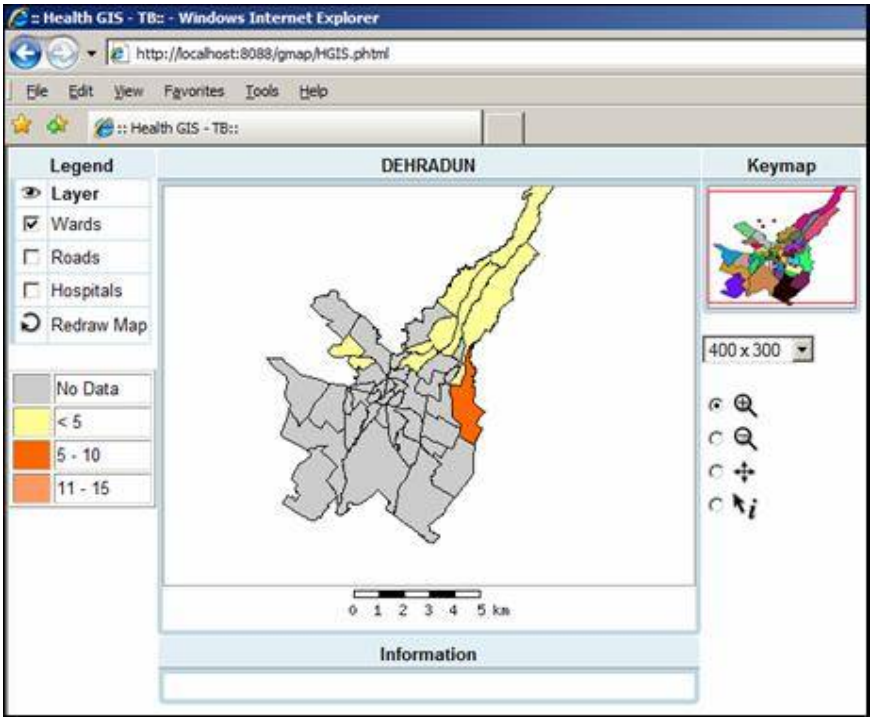

Figure 3: Main Interface

The administrative panel allows only the authorised users (in our case ward officials) upon authentication to update the database as and when new cases of patient suffering with disease are reported. The entered information is shown in real-time in the WEBGIS interface. Another functionality given to selected group of advanced users is to remotely manage the

database. It is implemented using another open source tool called phpPgAdmin [11] which is a web-based administration tool for PostgreSQL and allows easy backup and restore facility.

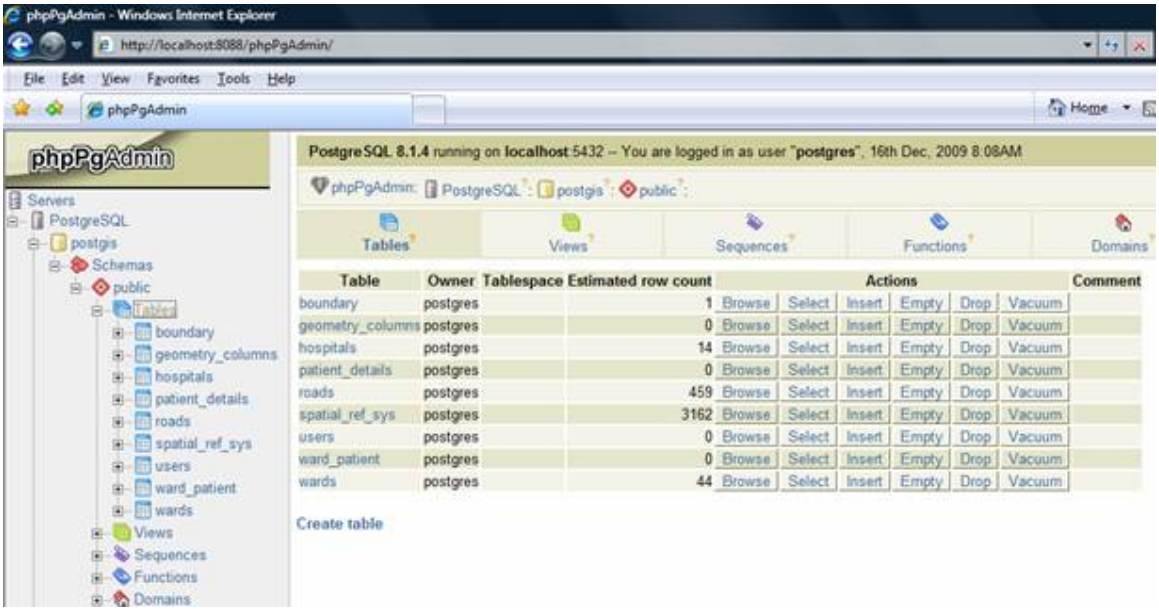

Figure 4: Remote database Administration

Results

Data shown in figures are not real and are used for explanatory purposes only. Based on the information entered by users via a simple administrative interface (given in figure 6, 7) system shows along with other textual details the interactive Dehradun ward wise disease map and pie-chart showing number of patient infected in particular ward upon user request (Figure 5).

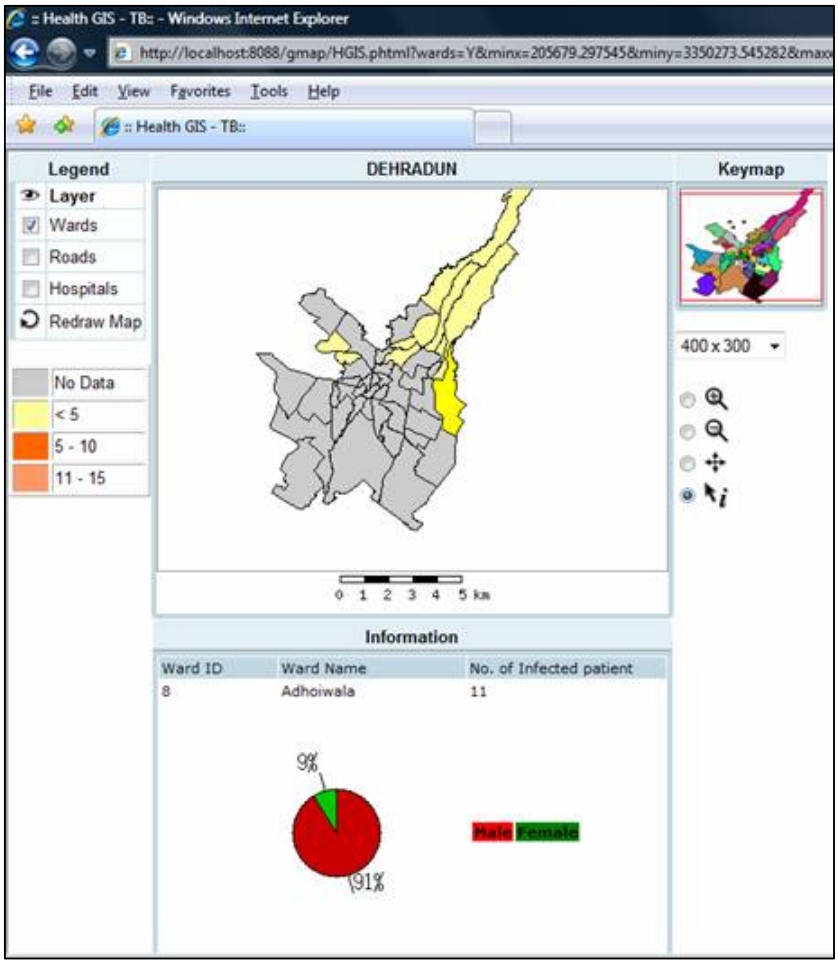

Figure 5: Query database and Result on the Map (Link between WEBGIS System)

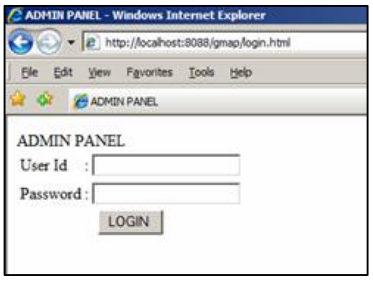

Figure 6: Admin Panel - Login Screen

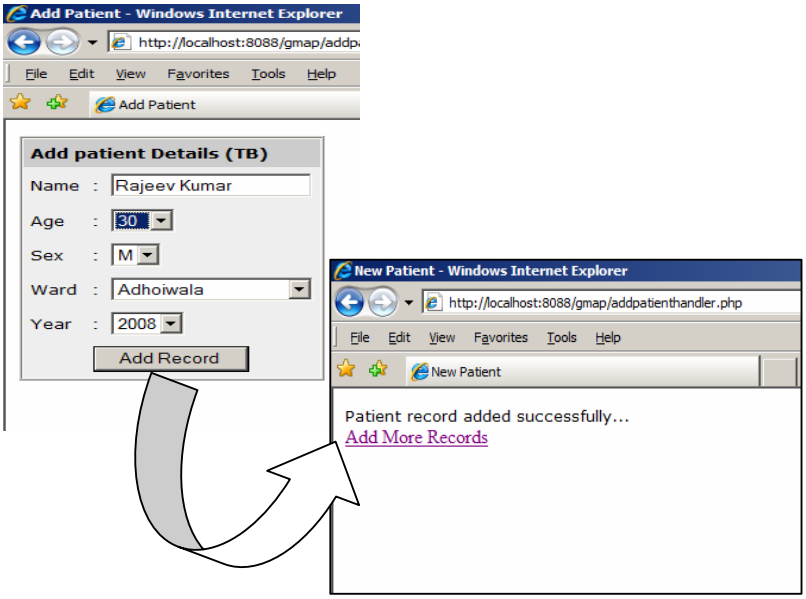

Figure 7: Admin Panel - Adding Patient details

Conclusion

Real-time web based geographical interface offer an intuitive way of managing, disseminating and analysing large health related information by the stakeholders. It also provides a very good tool for monitoring time-evolving geographical phenomena of various diseases instead of meagre textual online interface. Geographical interfaces are very useful in healthcare related areas as they provide instant comparison by visually looking at the temporal maps.

References

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