Healthcare Information System – A Web Based Spatial and Aspatial Helpdesk

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ABSTRACT: *Healthcare related Information is a most expected area focused by the people, Organization and government. This is the system or a Website established and considered as an information system provided by the particular hospital to the user, hence it's also termed as Hospital Information System. Information sharing with respect to spatial and Non-spatial forms through web will enable the user to have complete health related information such as Routing facility within the hospital where no labels and numbers are placed properly, Shortest routing Algorithm form blood banks to hospitals, E-doctor service (where user can clear the doubts, ask queries and prescription through web), Important medical terms, First Aid help desk, National health schemes, Ambulance services available etc. Open GIS is a best tool for accompanying the spatial routing task. System has followed 2 Tier Architecture in the development of E-doctor service where the consistent database will be maintained by the hospital server to update the queries instantly by the user. Spatial Routing will facilitate the user to find out the path from the entrance where they are standing to the appropriate building.*

Keywords: Web mapping, Spatial Routing, E-Doctor, First aid help desk, Blog service, PostgreSQL

I. INTRODUCTION

Healthcare information System is an emerging need of common people which has to be concentrated by the Government since the requirement rate of the people getting peak level now a days. The System is the one which accepts any form of input from the user, process it, and can provide desired output after processing the input. This project named as Health care Information System dealt with Spatial and Aspatial (which is also known as Non-spatial Information) information of Health related scenario. Spatial Information provides routing facility (Dynamic Web maps) where as Aspatial Information facilitates E-doctor, Blood banks details, National schemes announced by the government, emergency contacts, first aid helpdesk functions etc. There are more than ten Open Source technologies were used in structuring health care information System. One of the core Technologies used in this project is GIS (Geo-graphical Information System), a tool for capturing, manipulating, analyzing and modeling spatial as well as aspatial data with respect to real world entity. There are some commercial software's are available like Arc Map for handling spatial and aspatial data. But maps and associated information are meaningful only if it's accessible and operable by a layman. This can be done by publishing maps on the web with some interactive tools. Using Commercial software's to publish the maps on the internet is highly expensive and more technical skill is available to understand the working flow. To overcome from this issue there is an exploring technology which is getting updated every day called open source Web GIS is available to everyone at free of cost. Main Characteristics of open source are transparency (Source code can be downloaded by the user), Platform neutral (open source software can be installed at any Operating System environment), no licensing issue (the user will not be interrupted by asking license and all), Easy to upgrade, easy to learn (Documents are clearly provided which can make the user to learn the web processes quickly), and ensure more security etc but all are based on OGC Standards. The database which is capable of storing, manipulating, querying and retrieving data (Spatial and Aspatial) is PostgreSQL, and this the one used throughout the project work. On the whole it's a complete website handling spatial and non-spatial data to provide the user friendly page which in turn directs the person to the appropriate respond.

II. NEED OF THE STUDY

The existing hospital website is static which makes it less interactive. It doesn't have database connectivity. Moreover patients didn't have an access to the details of the hospital, services, and functions through the site, hence they were not updated about the latest events and placement drives. And mainly it didn't focus on spatial page development popularly known as web mapping which provides excellent routing system spatially with many tools embedded with it.In order to make the site dynamic and more interactive and effective, a database link to our hospital website and web mapping technologies are linked with the website. More Aesthetic styles are created for spatial entities using SLD Cookbook in geoserver to make the map which is shown on the web page more clearly to the people who use the system. The proposed spatial helpdesk has developed using the two tier architecture which uses the following languages and Technologies.

1. Geoserver 2.2
2. Mapserver 6.0.3
3. MapScript
4. Apache
5. PostgreSQL 9.2
6. QGIS (Quantum GIS) 1.7.4
7. PHP (Hypertext Preprocessor)
8. Jquery

9. JavaScript
10. OpenLayers
11. Geoext
12. XML (Extensible Markup Language)
13. HTML (Hyper Text Markup Language)
14. Flash
15. CSS (Cascading Style Sheet)
16. Photoshop

All technologies mentioned above are an open source technology. Any time developer can download it and use without any interruptions. Most frequently these open source applications are getting updated with new innovations with appropriate documents. This makes the developer to update the system frequently with more advancement.

III. AIM

To develop a complete website with the combination of spatial (Web Mapping) and aspatial pages for Healthcare information System to provide health related services to common people.

IV. OBJECTIVE

1. To develop the routing Algorithm to find out the shortest route from important blood banks to the government hospitals around Chennai with the aid of PostgreSQL, PHP, OpenLayers, MapScript, Mapserver, JavaScript, QGIS, Photoshop and HTML.
2. To develop a Dynamic Interactive web map for providing route from the entrance of the hospital to the appropriate building using Geoext, JavaScript, XML, Geoserver and QGIS.
3. To create an E-Doctor Section by establishing connection between database and user page using PostgreSQL and PHP.
4. To develop a complete website to integrate the spatial web map page and Aspatial helpdesk page using HTML, flash, CSS, PHP and Jquery.

V. STUDY AREA

Stanley Hospital, Chennai.

It's located in 13.09758 Latitude and 80.29456 Longitude. Stanley hospital extents from has an area of 22,343 m2.Stanley Government Hospital, one of the oldest and pioneering hospital for excellence in India. The seed for this institution was sown as early as 1740, The East India Company first created the medical department. The hospital has an out-patient attendance of around 5000 patients per day. A unique feature is its 8-story surgical complex equipped to perform up to 40 surgeries simultaneously, and a separate pediatrics block with all specialties under one roof. RSRM hospital is also attached for obstetrics and Gynecology care.The three well known departments of the Stanley Medical Hospitals are Surgical Gastroenterology, Urology and the Institute of Hand Rehabilitation and Plastic Surgery. The Institute for Research and Rehabilitation of Hand and the Department of Plastic Surgery (IRRH & DPS) is one of the best centers in Southeast Asia. The Department of Surgical Gastroenterology was the first in India to perform a successful liver transplant, Surgical Gastroenterologist and the first among Hospitals/ Hospital Departments in India to obtain the ISO 9001 certification. The Department of Urology performs up to fifty kidney transplants a year.

Study area selection is significant because this is the main factor which will make the project effective and successful. So initially a small survey has been took in government hospitals of Chennai where the area is large and the people have been suffering in finding the required department since the label and numbers are not that much visible and proper. Stanley is a government hospital, where people are very much suffering in finding the departments and this is the hospital which is not even having website for providing healthcare information at free of cost. So the project mainly concentrates on website creation for Stanley hospital which is also incorporates interactive web map routing system.

VI. METHODOLOGY

6.1 DATA COLLECTION

Data has been collected from the Stanley hospital by taking Google imagery and GPS on hand. Routes are collected as a linear segment from GPS. Mean while various routes inside the hospital boundary, departments, and blocks are also traced on the map. Building blocks and associated attributes like department name, working hour, number of floors, department in each floor etc are noted manually and this information have been entered as a Aspatial data while creating spatial information of those collected earlier. Area and extent has been calculated in QGIS.Chennai Data such as Road network, Point of Interest, and boundary are collected from cloudmade website.

6.2 COMPONENTS OF WEB FORM
➢ Home Page Design
o First aid Helpdesk
o Emergency Contacts
o Blood Banks Details
o Ambulance contacts

o   Important Medical Terminology
o   National Health scheme
➢   Spatial Touch Design also known as Interactive Web mapping Service
➢   Route Planner, comes under web shortest route algorithm
➢   Blog Page design
➢   E-Doctor Design
➢   Satellite View of the hospital
➢   Spatial Help Desk – an Overview

6.3 ARCHITECTURAL MODEL
        The project operates on 2 tier Architecture principle. Client and Server are the two tiers. This architecture is also called Client-Server architecture because of the two components: The client that runs the application and the server that handles the database back-end. When the client starts it establishes a connection to the server and communicates as needed with the server while running the client. The client computer usually can't see the database directly and can only access the data by starting the client. This means that the data on the server is much more secure. Now users are unable to change or delete data unless they have specific user rights to do so. The client-server solution also allows multiple users to access the database at the same time as long as they are accessing data in different parts of the database. One other huge benefit is that the server is processing data that allows the client to work on the presentation and business logic only. This mean that the client and the server is sharing the workload and by scaling the server to be more powerful than the client, you are usually able to load many clients to the server allowing more users to work on the system at the same time.
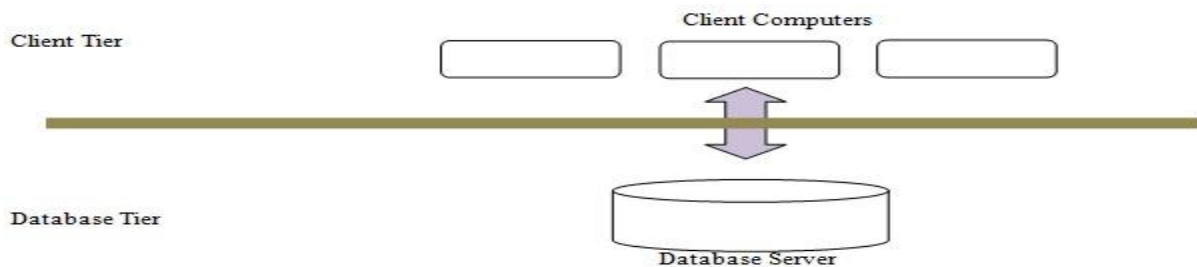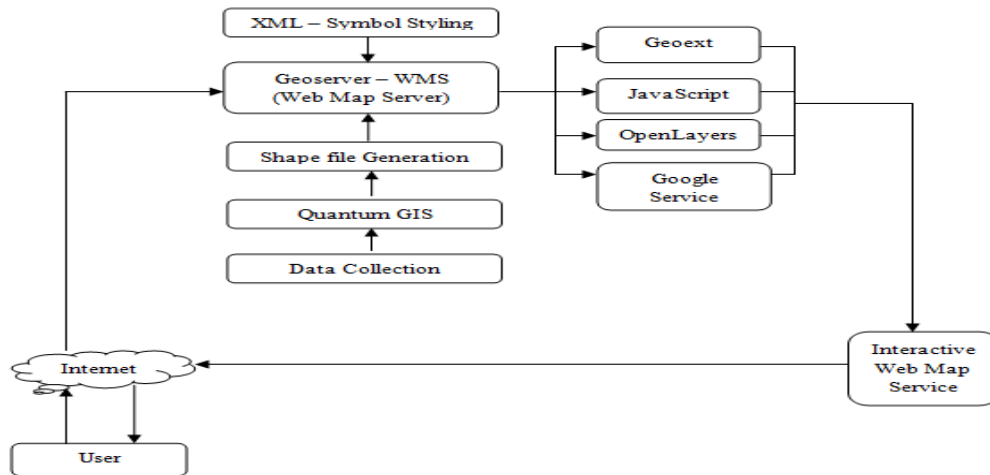

Figure 1

6.4 GENERAL WORK FLOW

Figure 2

6.5 HOME PAGE DESIGN
        The home page of a website is the first page that a user perceives upon entering the website URL at the browser address area. It forms the abstract of the entire website. Photoshop is used in the design of logo placed at the top of the web page. HTML, CSS (Cascading style sheets), Jquery and Flash scripts are written for designing the webpage. The Page Consists of several health information such as First aid helpdesk for providing first aid guidelines in the case of emergency, Medical terminology which should be known by the common people, Ambulance services around Chennai, Emergency contacts, Blood banks details, Some updated Government scheme which is not known to the people, and spatial helpdesk to guide the people about the spatial web map service so that everyone can understand how to operate this system to obtain efficient information with respect to spatial and aspatial data. Home page is shown in figure 3.Other services like Emergency contacts, blood bank details, government scheme are available in every page/ function at bottom.

6.6 WEB MAPPING DESIGN
        It's named as Spatial Touch function. Generally this web mapping application is developed to aid people who suffer very much to find the way from the entrance to the corresponding department in case of emergency. This one click application will make people to know the path and location of the desired department by clicking only once on the page which in turn deviate the view from Aspatial to spatial map. QGIS application is used in developing spatial data of hospital

blocks, route inside the hospital, outer road, railway line and boundary as shown in figure 4 and figure 9. Once a request is sent from the user to GeoServer for the data to render in the map viewer, then the data can be transmitted from server to user as a as an image (via a Web Mapping Service (WMS). Spatial Web map shows the direction from where the people are standing and the route to the appropriate building. It's an Interactive web map where user can inquire the map to know the details of road, building and its function, railway line etc. They can also remove the map from the legend panel, add the map from the server, option provided at the right panel, refresh and back to the spatial touch. The technologies used in the development of web maps are specified below.
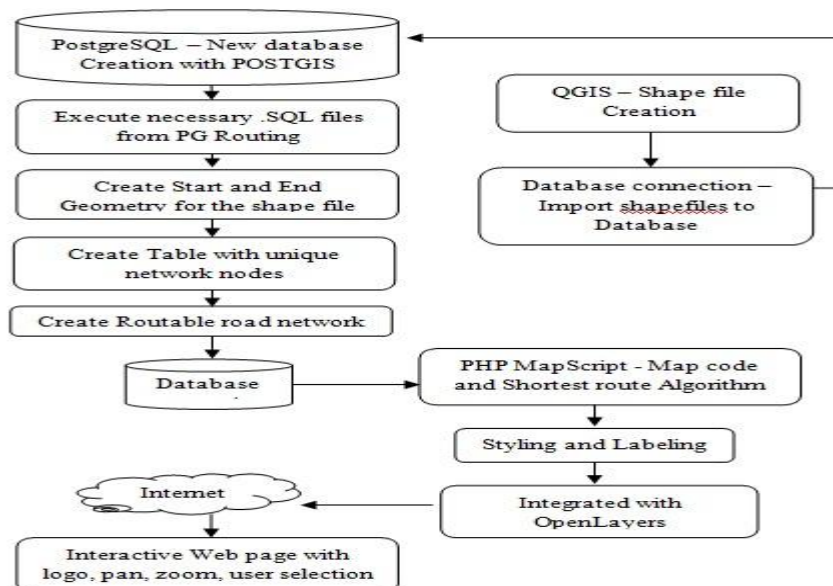

Flow Chart 1: Spatial Touch System Flow Diagram

6.7 ROUTE PLANNER

Route Planner is a section where shortest route algorithm has been incorporated to show the shortest route from the important blood banks to the hospitals with transfusion department. PGRouting has been installed in the database such that the all 802 functions are taken their place in the appropriate database required for running routing algorithm. This Installation has been done by running three sql files as mentioned below

- routing_core.sql
- routing_core_wrappers.sql
- routing_topology.sql

QGIS is used in the creation of shape files of Chennai road network, hospitals with transfusion medicine, blood banks and bust stop as shown in figure. The road network and shape files are converted to a database file and loaded in the database where the PGRouting functions are installed. The PHP MapScript coding for publishing base maps and shortest route are put together in OpenLayers JavaScript to make a page as an interactive one. Each time, at user query, the database has been connected and shortest route geometry has been retrieved and plotted as a line on the web. Finally 4 Google service such as Google street, Google physical, Google hybrid and Google Satellite have been called to make the web map user friendly. The complete route planner has been shown in figure 7.

Flow chart 2: Route Planner System flow Diagram

6.8 E-DOCTOR

E-doctor is an important service which would be act as online doctor where people may ask their doubts, queries, even prescription from the effective doctors through online. If the doctors think that the query is significant, the suggestions are posted in blog section. This Service has been developed by establishing connection between database (server) and Web page from where the people can shoot their questions. PHP plays a vital role to accomplish this task. Through this connection the submitted query has been getting updated in the DB which is located in the hospital server. Since the query updation has been taken place to the appropriate department, only authorized can access the database by providing password authentication to the database. E –Doctor web page shown in figure 5.

6.9 BLOG SERVICE

Blog service is generated using simple HTML and CSS functionalities. This section is for updating the suggestion from query asked, latest inventions, etc.. If the doctors think that the question raised from the person is significant, and everybody should know about it, then the answer from the doctors will be posted in the blog. Latest inventions in medical field are also updated frequently in the blog. The blog service page is shown in figure 6.

VII. RESULT AND DISCUSSION

7.1 SYSTEM TESTING

Testing is a set activity that can be planned and conducted systematically. Testing begins at the module level and work towards the integration of entire computers based system. Nothing is complete without testing, as it is vital success of the system. The testing process steps are mentioned below

7.1.1 Integrated Testing
7.1.2 Output Testing
7.1.1 INTEGRATED TESTING

Spatial and aspatial data are integrated in this system. While conversion of spatial data to database file, the cross checking or testing is necessary since the conversion creates the geom field in the database. While providing link from Aspatial web page to spatial webpage there must be adequate level of integrated testing is necessary. This application is browser sensitive, means it can able to run all the functions effectively only on the Internet explorer.

7.1.2 OUTPUT TESTING

This is the final step in testing. In this the entire system was tested as a whole with all forms, code, modules and class modules. This form of testing is popularly known as Black Box testing or system testing.

Black Box testing methods focus on the functional requirement of the software. That is, Black Box testing enables to derive sets of input conditions that will fully exercise all functional requirements for a program. Black Box testing attempts to find errors in the following categories; incorrect or missing functions, interface errors, errors in data structures or external database access, performance errors and initialization errors and termination errors.

The prototype visualization tool has developed successfully which enable users to spatially visualize hospital Information within a web browser, without the need for any additional software, or software training. The complex workings of the system are hidden from the user and the automatic rendering design used in this system enables users with no prior knowledge of GIS to visualize their data and immediately gain some understanding of the spatial structure of their data. In comparison to that of commercial closed source software, open source is more complicated to initially implement. Although there is no specific dedicated customer support service, the support and advice provided by users in the open source community through forums and mailing lists is extensive, and there is a large community devoted to help and share ideas which can inspire "out of the box" thinking on solutions which may not be possible in closed source applications. The System developed can also be placed at the hospital entrance to meet the user's routing need in the case of emergency.

Although the Information System are integrated with spatial and Aspatial web pages there are some unavoidable limitations present. Some tools developed in the open source environment may be browser dependent and some may not be. So there is a need of crucial knowledge to finalize the browser from where it has to take move. Some of the Information like Doctors at OP, Timing, Oxygen supply storage, and Patients incoming record should have been included in the system since it's a system deployed by the hospital.

VIII.   FIGURES / WEBPAGES

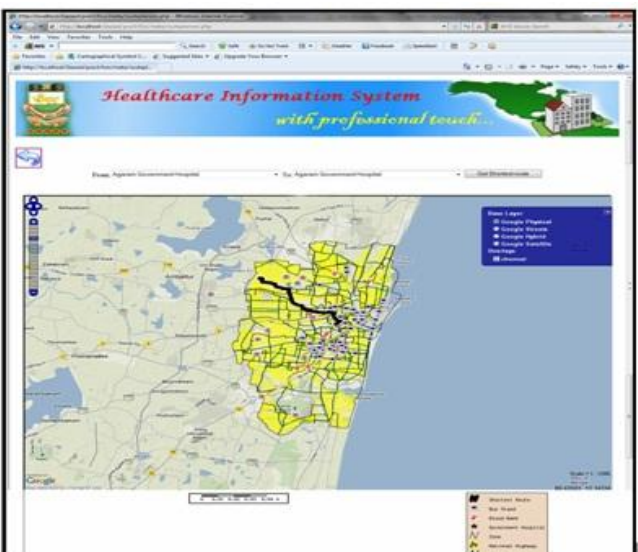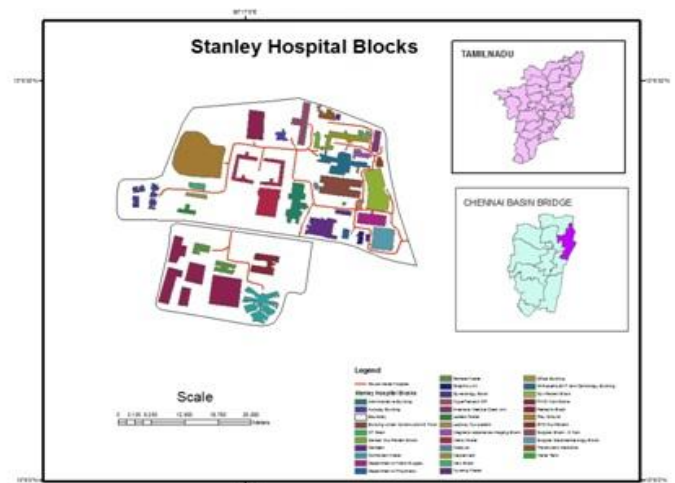
Figure 3

Figure 4

Figure 5
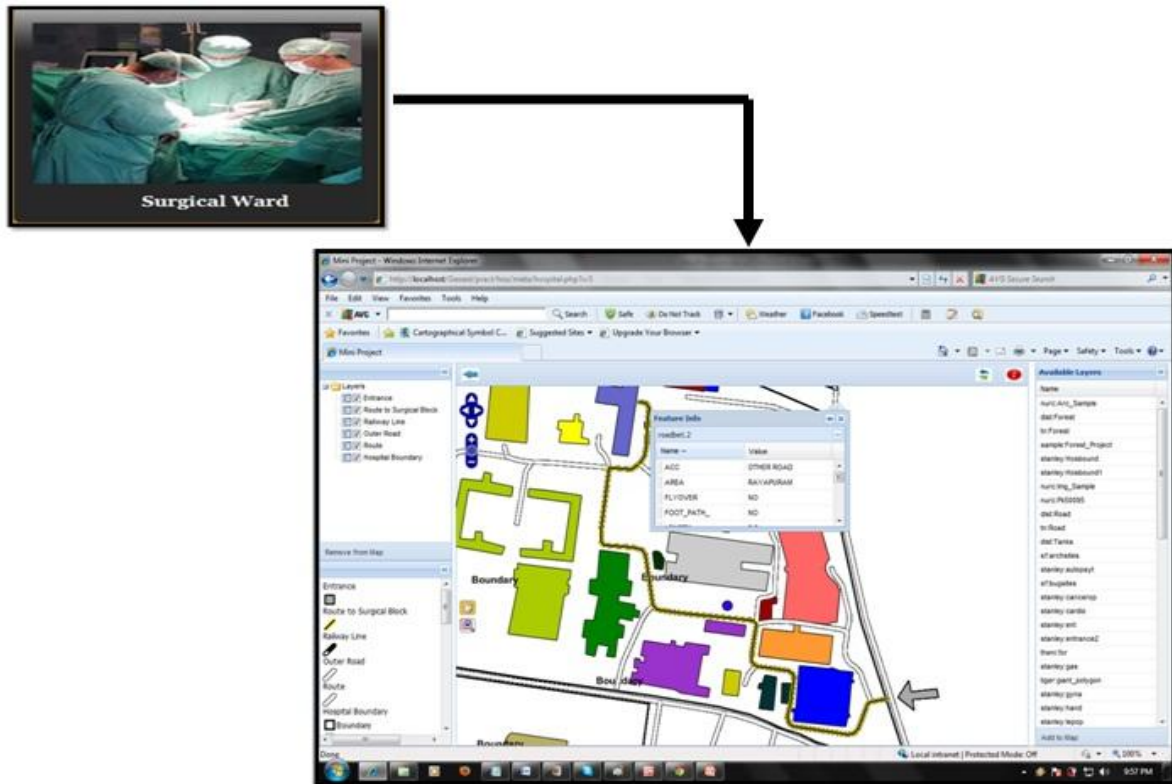

Figure 6

Figure 7

Figure 8

Figure 9

IX. ACKNOWLEDGEMENTS

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