

WEB ENABLED GIS BASED NAVIGATION INFORMATION SYSTEM USING NETWORK ANALYSIS CAPABILITY A WEB GIS APPROACH

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Abstract: GIS is a technology that is used to organize, analyze, and distribute spatial data for day-to-day operations as well as in research, engineering, and facility management. Here the integration of roads, buildings, landmarks, routes availability can make GIS a valuable tool in navigation. This application aims to establish a Web enabled GIS based Navigation Information System for Bhopal City including facility such as shortest route and closet facility by length and time. Presently the scope of this application is for every person which is not friendly with any place, which can plan the tour more efficiently and effectively by getting the valuable information for various places and the types of facilities around the area of interest and can generate route in order to see the most feasible route and facility depending upon the requirements of the user.

First, Digital intercity road network database is constructed for Bhopal City using high resolution satellite data in ArcMap and visualized database management programs are developed to realize a Graphical User Interface (GUI). Second, Using network analysis capability in the database for “shortest-route & closet facility searching” module is developed, based on topology for road network and the traffic attributes of links, the module allows users to select nodes and display the shortest-path & closet facility in GIS map window visually. Further, after deploying and publishing them to server (e.g. ArcGIS Server) through Web GIS module, remote users can visit the GIS application through Internet. Users can manage the road information more systematically and scientifically with this system.

Keywords : Shortest Route, Closet Facility, ArcGIS, ArcGIS Server.

I INTRODUCTION

People everywhere need to get somewhere else and are dependent on Buses, trains, airplanes or any vehicles to arrive at a destination. Most of the people would like to

arrive at a destination in the least distance and time. Routes and Networks are the interconnected features that are used for transportation including highways, railways, city streets, rivers and utility systems. Networks are an important part of our everyday lives and analysis of these networks improves the movement of people, goods, services and the flow of resources. [1] Network analysis in GIS is often used to find solutions to transportation problems by using either vector or raster models to represent the real world.[2] The Network Analyst extension for ArcMap solves problems of any interconnected set of lines these lines may represent traffic network on streets. It can find the shortest route and closet facility according to user's search. It can search whether one place is linked or not to another. Network Analyst can also build spatial models of traffic flow.[3] In the Bhopal city, the roads were not designed perfectly as it is in the modern cities. Roads are scattered as well as houses are numbered randomly. So it is very tough to find a location or house for a new comer as well as an inhabitant of this city too. Moreover many of the roads are blocked due to heavy traffic jam. As a result travelers suffers from a wasting their precious time on the road. So they need an assistant to guide them to proper way. This application “Web enabled GIS Based Navigation Information System” for Bhopal city can navigate the traveler along the shortest path & closet facility based on distance or time. The main aim of this study is to develop an efficient Web enabled GIS based Searching System, for the improvement of navigational information through solving the routing problems when a emergency or critical situation occurs on Bhopal road networks.

II STUDY AREA

The area for this study is the Bhopal City. The geographical location of the study area, an intercity road network of the Bhopal City lies within Latitude: 23° 07' N to 23° 54' N, Longitude: 77° 12' E to 77° 40' E. It is covered in SOI toposheet number 55/E-7 and 55/E-8. National Highway 12 (Beora Jabalpur), which links the city to many large cities in the North West and the South East. State Highways connect Indore and Sagar.

III METHODOLOGY

The Web enabled GIS based Navigation Information System follows a step by step process. When users want information related to find the best/shortest route and closet facility.

There are two types of application which are given below:

- 1) Desktop based Application
- 2) Web enabled Application

Desktop based Application

For creating this application steps are given below;

- Digitization of the road network by using High Resolution Satellite Data
- Database creation
- Topology Creation
- Geoprocessing
- Network Analysis

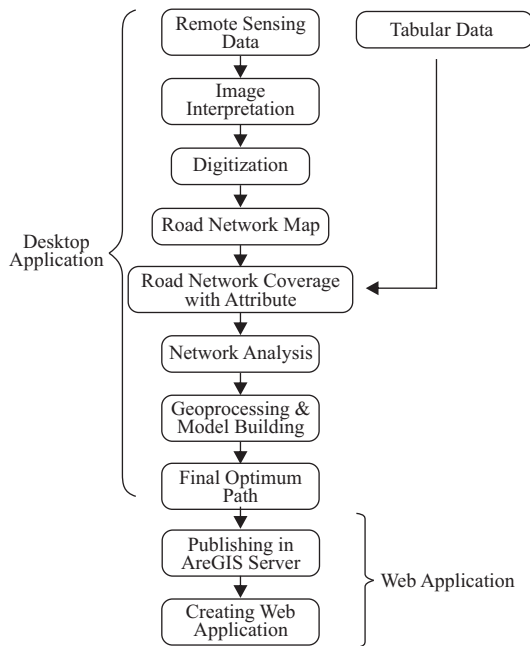


Fig. 1 Flow Chart showing the Methodology for Web enabled GIS based Navigation Information System.

Web enabled Application

The aim of this application is to facilitate the remote users, via using Internet technology, because Internet is the only way to provide the map from server via computer.

A. Available Data

The data available to the application is the intercity road network & POIs (Point of Interest e.g. Landmark) in the form of shape file format.

B. Determination of Functionality

For the searching system application the functionality has been decided in context of user's requirements. This application provides searching functionality as zoom, pan shortest route & closet facility search, identify and measure.

C. Defining Map Contents

These criteria are also important because the interaction of user and map depend on the map content for display. In this application the landmark name are displayed with field labeling. So that user could be able to visually identify their respective place or location.

For displaying the map we choose the image service because it returned the map in JPG, PNG or GIF format. There is no need for feature streaming capabilities, so image service used.

D. Choosing the Viewer/Interface

The ArcGIS SERVER provide two types of interactive interface based on functionality and technology used. First kind of viewer known as HTML/XML viewer, which is simple and lightweight, while the other, Visual Studio .NET viewer is more advanced and applet based. Each viewer is different and has own advantages.

In this application we need functionality and system support in available resource. After considering following facts the Visual Studio .NET viewer is found sufficient, the Visual Studio .NET viewer is used most effectively because;

- Supporting a variety of browsers.
- More advanced and more user friendly
- Extended technology support.
- View and query are the only required function
- Enhanced navigation.

The .NET viewer is the simplest and fastest to implement. It is compatible with any Web browser.

IV CUSTOMIZATION/DEVELOPMENT

A. Deployment of Application

The Arc GIS Server provides the web deployment facility for web application. Generally web deployment depends on the web server type, because in this application the web server used in Internet Information Services (IIS Manager). In this application the virtual directory, this is created during the post installation process. And the default storage directory for the files used in the application, situated in Arc GIS Server default directory.

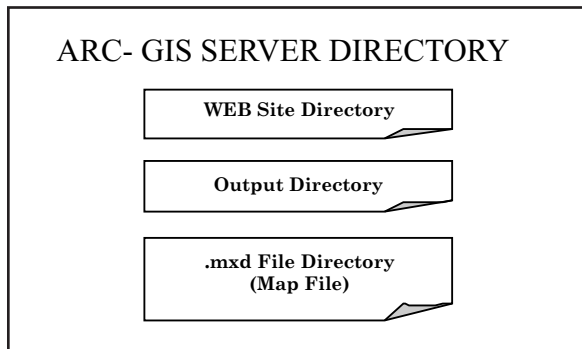


Fig. 2 Showing ArcGIS Server sub directories.

B. Creating Image Services

This is a basic step towards the application development to creating a separate image service for road network map that would be published on the web. It uses the Arc GIS Server image rendering capabilities. When a request received, a road network map is generated on the server, and response is sent back as a JPEG, PNG or GIF image. A new map image is generated each time when client requests new information. The image service is the system process which continuously running in back ground and it is instance of any particular map file.

Map file is nothing but a collection of tags and information that follows the Arc XML specification.

C. Publishing Map Services

Before create a map service, it should be created an ArcMap map document (.mxd) that resides in a shared location visible to all server object container (SOC) machines in the GIS Server. The SOC account we created during post installation also has permissions to read the map document and all the data that the map document references.

D. Publishing Network Analysis Services

The network analysis service requires a map service

that contains one or more network analysis layers. So the map document published to ArcGIS Server must contain one or more layers i.e. network analysis layers.

Arc GIS Server supports performing network analysis on network layers. This includes finding the shortest route & closet facility to an incident.

Resources in ArcGIS desktop and publishing to the ArcGIS Server as services so that client side applications can use. The table 1 summarizes the services that are available and the GIS resource required for each one.

Table 1: Showing the services in ArcGIS Server and their required GIS resources.

Service type	Required GIS resource
Map service	Map document (.mxd, .pmf) or map service definition (.msd)
Geocode service	Address locator (.loc, .mxs, SDE batch locator)
Geodata service	Database connection file (.sde) or personal geodatabase or file geodatabase or map document referencing data from a versioned geodatabase
Geometry service	Does not require a GIS resource
Geoprocessing service	Map document with a tool layer or toolbox (.tbx)
Globe service	Globe document (.3dd, .pmf)
Image service	Raster dataset or mosaic dataset or layer file referencing a raster dataset or mosaic dataset

E. Create Web Application

- Using ArcGIS Server Manager to create and deploy a fully functional WMS application.
- By the Manager the process of selecting which services to display, configuring tasks, geoprocessing task, Find Task and choosing the look and feel Web application.
- Once created the application, edit it in Manager.
- Make advanced customizations; open the application in an integrated development environment (IDE) such as Microsoft Visual Studio.

V RESULT

In this application a Web enabled GIS Based Navigation Information System has developed which is a lightweight viewer that allows to user to interacting with a Map Services using a simple yet powerful set of GIS tools. The mapping service is based on WMS (Web Mapping Services) to publish online. A tool for shortest route and closet facility has developed at the desktop/standalone platform based on geoprocessing capability. After successful desktop implementation this tool has been carried out at server/web platform. The advance Arc GIS Server has extended the capability of geoprocessing at web platform. Thus, the same powerful capabilities of the geoprocessing at web platform like desktop.

It could be easy to incorporate more tools but as per the requirement of the application tools are confined with respect to certain criteria and ease of use.

The application viewer is lighter but suits with the need as the target is to provide the maximum simple operation for navigation and minimum requirement for query and other advance tools because it may increase the complexity of application and will not go smoothly with old fashioned web browsers/mobile devices. GUIs of shortest route and closest facility using Network Analysis capability in Arc GIS Desktop Environment

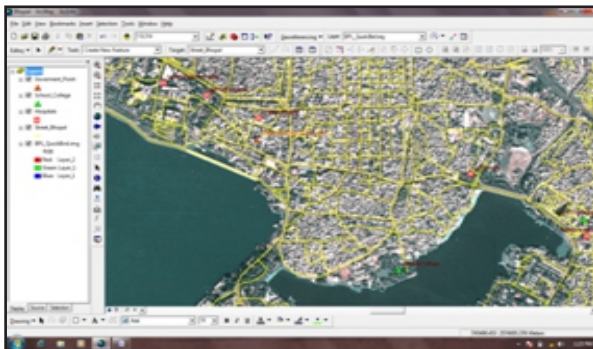


Fig. 3 Showing Road Network of Bhopal City on High resolution Satellite imagery.

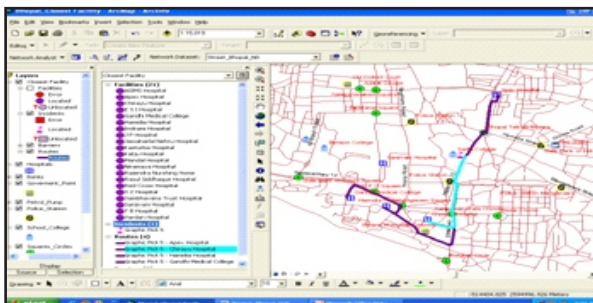


Fig. 4 Showing the optimum route in terms of Closest Route from an Incident point to Facility point

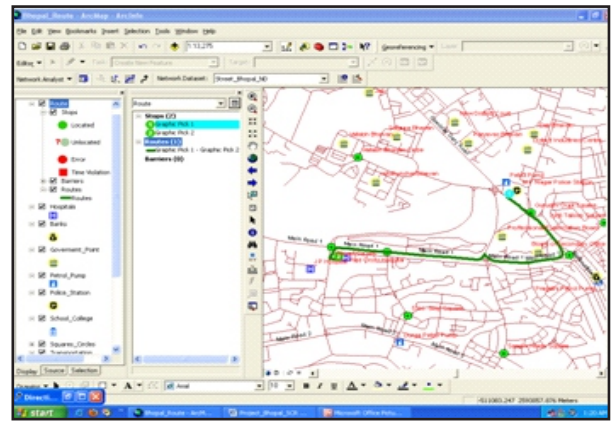


Fig. 5 Showing the Best Route in terms of Shortest Route/Path from an Incident point to Facility point

GUIs of fully functional web enabled application for shortest route and closest facility in Arc GIS Server Environment

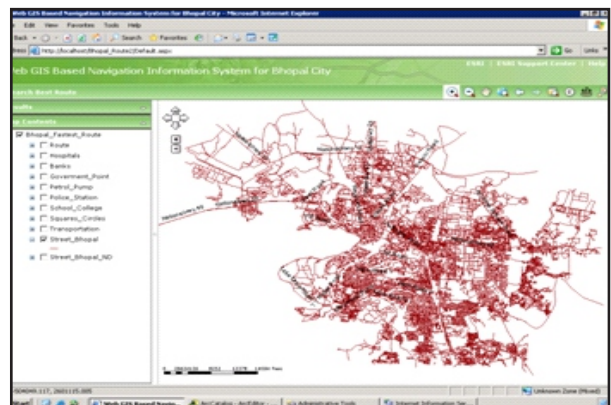


Fig. 6 Showing the window of Web enabled GIS based NIS for Bhopal City

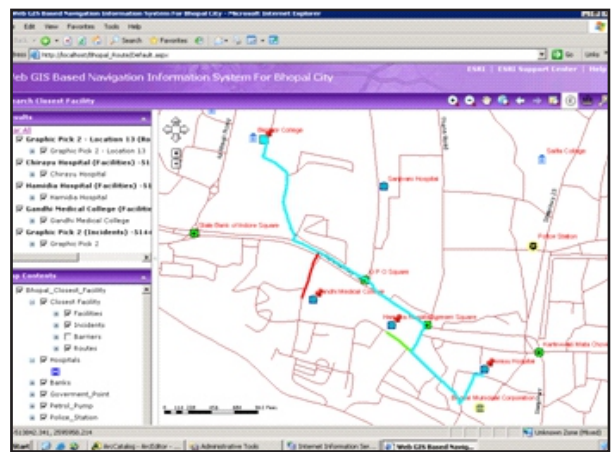


Fig. 7 Showing the result window of Web enabled GIS based NIS for finding closest facilities from an Incident

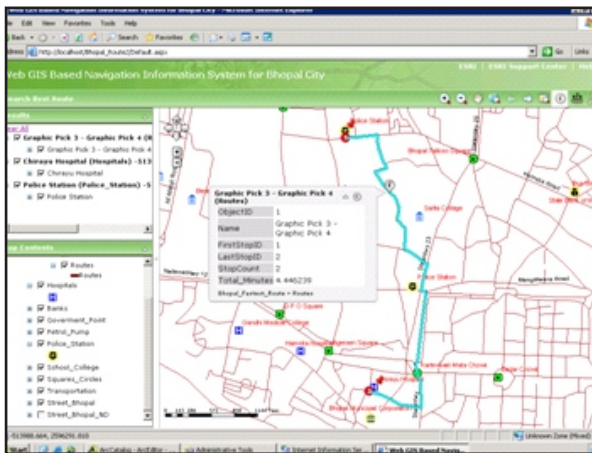


Fig. 8 Showing the result window of Web enabled GIS based NIS for searching shortest route from an Incident to Facility point

VI CONCLUSION

Web enabled GIS based NIS is most widely deployed ITS application areas. With the rapid increase of the internet and wireless communications in recent years, the internet based and wireless applications to NIS are growing rapidly. Implementation of GIS in combination with other advanced communication computer technologies to navigation information systems enables the specific dissemination of information related to fixed route facilities, such as offices, educational institutions, and health facilities, places of tourist interest, etc.; route planning and spatial and attribute information on other transportation facilities within the cities.

This Web enabled GIS based NIS has a point-and-click graphical user interface and also is user friendly. The developed application has the following capabilities:

- 1) Finding the shortest route based on distance and drive time;
- 2) Finding the closet facilities based on distance and drive time;
- 3) Search engine which searches different facilities in Bhopal city;

This application can be used as:

- 1) Emergency Response System
- 2) Banks & ATMs locater
- 3) Tourist Information System
- 4) Facility Search System (i.e. Hospitals, Petrol Pump, School & College, Restaurant etc.)

With the more complex applications this application could be demonstrated in more informative way or demand specific. But in this study the aim was to

develop a simple web enabled application which could be accessed at most of the platforms and devices.

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