

**CROSS/
ROADS**
LINKING MOBILITY SOLUTIONS



**IRF WORLD ROAD
MEETING 2017**

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**APPLICATION OF INTELLIGENT
TRANSPORT SYSTEMS (ITS) FOR
DEVELOPING COUNTRIES**

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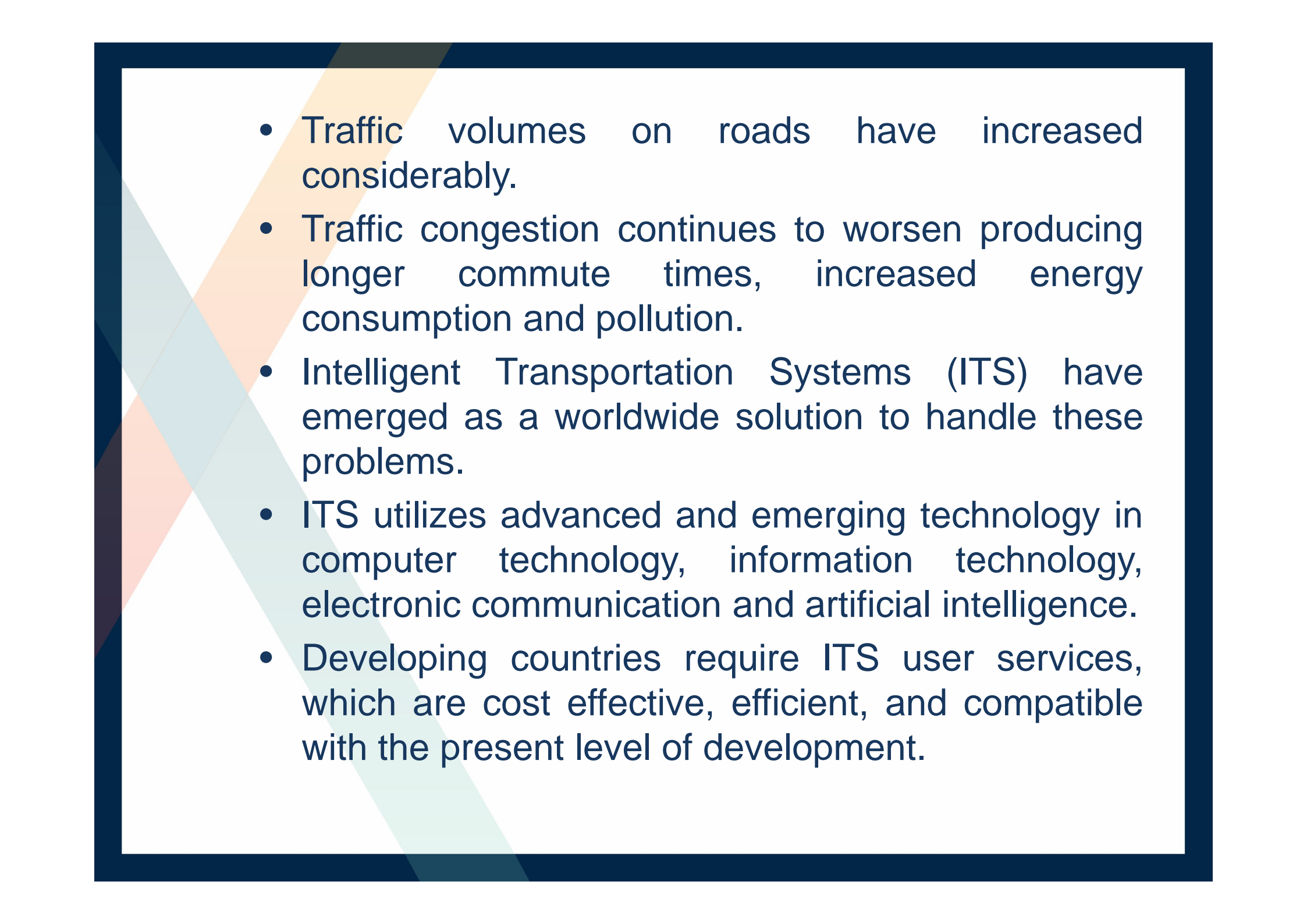
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INTRODUCTION

- 
- Traffic volumes on roads have increased considerably.
 - Traffic congestion continues to worsen producing longer commute times, increased energy consumption and pollution.
 - Intelligent Transportation Systems (ITS) have emerged as a worldwide solution to handle these problems.
 - ITS utilizes advanced and emerging technology in computer technology, information technology, electronic communication and artificial intelligence.
 - Developing countries require ITS user services, which are cost effective, efficient, and compatible with the present level of development.

- Lack of better information system, lack of demand based bus route optimization and less public transportation facilities have resulted in heavy shift of commuters to private and intermediate transport.
- Better information about the actual arrival and dispatch timings of the buses are needed through Advanced Traveler Information System (ATIS).
- Need of better and optimized bus routes are being felt to be studied on the basis of the travel data collected.
- Advanced Public Transport Systems (APTS) that have solution to buses, traffic management officials and the travelers as a whole.

- The applications of ITS technologies to APTS are specific to improving the efficiency and user-friendliness of public transport services.

They include:

- Improved information systems to disseminate timetables.
- Fare and ride-sharing information through the internet and other media.
- Automated fare collection systems.
- Vehicle locator systems for improved fleet management.
- Increased security
- Communicating to passengers the arrival time of the buses.

- ATIS aims at bridging the information gap between travellers and transportation authorities by implementing computer, communication, information technologies and management strategies.
- ATIS also disseminates valuable dynamic traveller information like traffic, incident and transit information, keeping the travellers updated about prevailing roadway, traffic and ridership scenarios.
- This traveller information is created after mining complex set of spatial, non-spatial and dynamic data on basis of information requested by the traveller.
- Hence proper storage and management of data is critical for successful functioning of ATIS.

USER SERVICES OF ITS

1. Advanced Traffic Management System (ATMS)

Transportation Planning Support

Traffic Control

Incident Management

Demand Management

Policing/Enforcing Traffic Regulations

Infrastructure Maintenance Management

Advanced Traveller Information System (ATIS)

Pre-trip Information

On-trip Driver Information

On-trip Public Transportation Information

Personal Information Services

Route Guidance and Navigation

Advanced Vehicle Control Systems (AVCS)

Vision Enhancement

Automated Vehicle Operation

Longitudinal Collision Avoidance

Lateral Collision Avoidance

Safety Readiness

Pre-crash Restrain Development



Commercial Vehicle Operation (CVO)

Commercial Vehicle Pre-clearance

Commercial Vehicle Administrative Process

Automated Roadside Safety Inspection

Commercial Vehicle Onboard Safety Monitoring

Commercial Vehicle Fleet Management

Advanced Public Transport System (APTS)

Public Transport Management

Demand Responsive Transport Management

Shared Transport Management

Emergency Management System (EMS)

Emergency Notification and Personal Security

Emergency Vehicle Management

Hazardous Material and Incident Notification

Electronic Payment (EP)

Electronic Financial Transactions

Safety

Public Travel Security

Safety Enhancement for Vulnerable Road Users

Intelligent Junctions

System Architecture of ITS

- System architecture is a framework within which the individual ITS services and functions such as traffic monitoring, incident detection, and emergency support can be developed.
- It clarifies how components of the system affect each other and work as one.
- And it stipulates functions of the entire system and each subsystem.
- The main strength of system architecture is that it provides the strategic framework through which various activities can be integrated.

Geographic Information System

- Geographic Information System (GIS) is a technology where accurate geographic representation of system and subsequent spatial analysis are important for modeling and analyzing the geographically referenced information.
- Application of GIS technologies in transportation systems led to the development specialized field known as Geographic Information System for Transportation (GIS-T)
- GIS-T is used to collect, analyze and output information describing the physical and logical properties of the surface of the earth occupied by the transportation networks.



**RESEARCH WORK
CARRIED OUT AT IIT
ROORKEE**

2. Software for Ring Road of Delhi

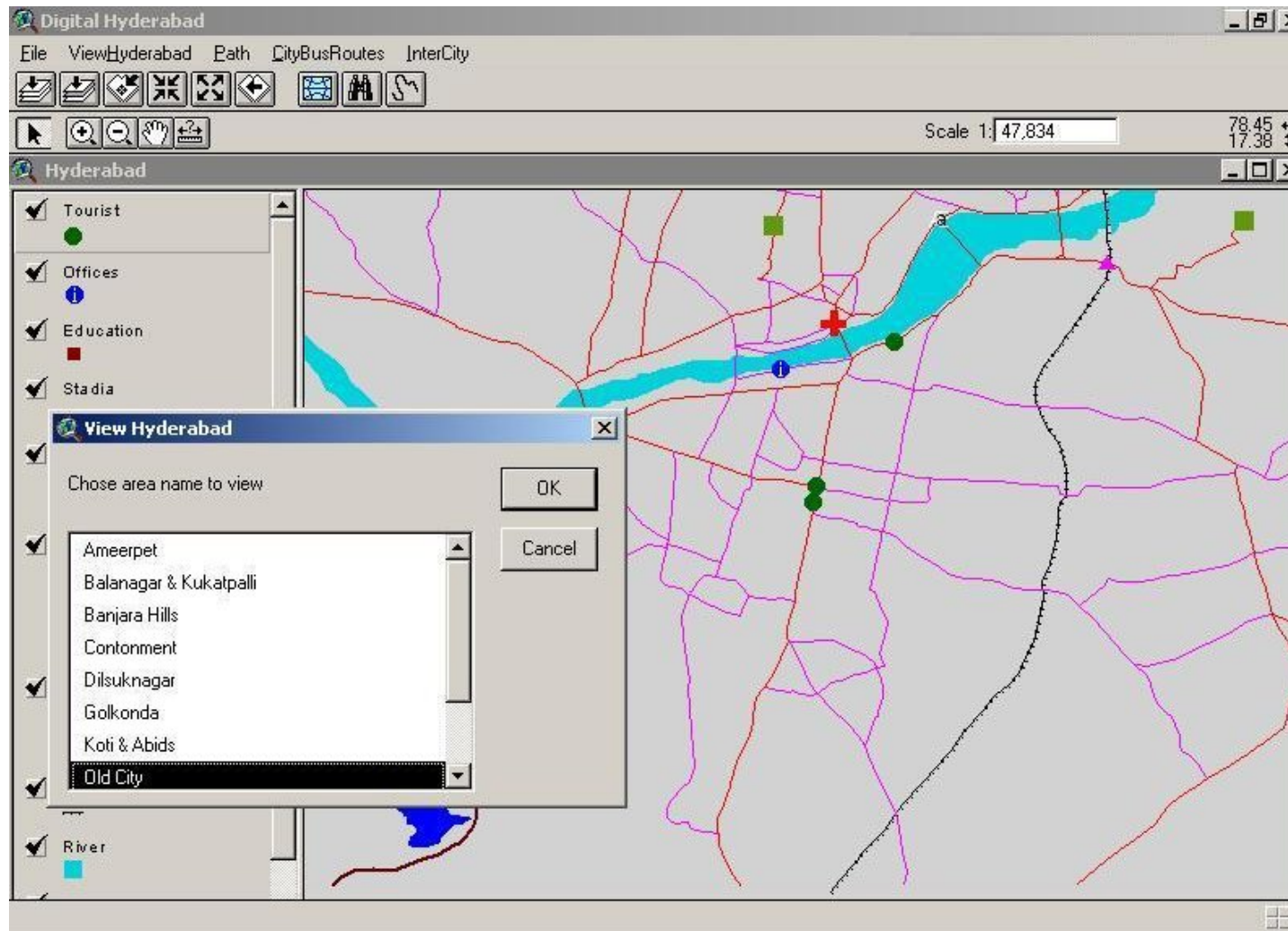
- Computer program developed uses the input data (speed and direction of vehicle) to predict the traffic behavior on road.
- The data collected from each segment like density, type of accident, facilities available and duration of facility had been inputted to the model.
- The output of model predicts type of situation that can be occurred in the next block.
- With the application of model, the information is flashed on the screen and driver can take decision whether he has to enter the next block if situation is favorable or choose the alternate route if situation is not favorable as predicted by the model.

4. GIS based Advanced Traveller Information System for Hyderabad City

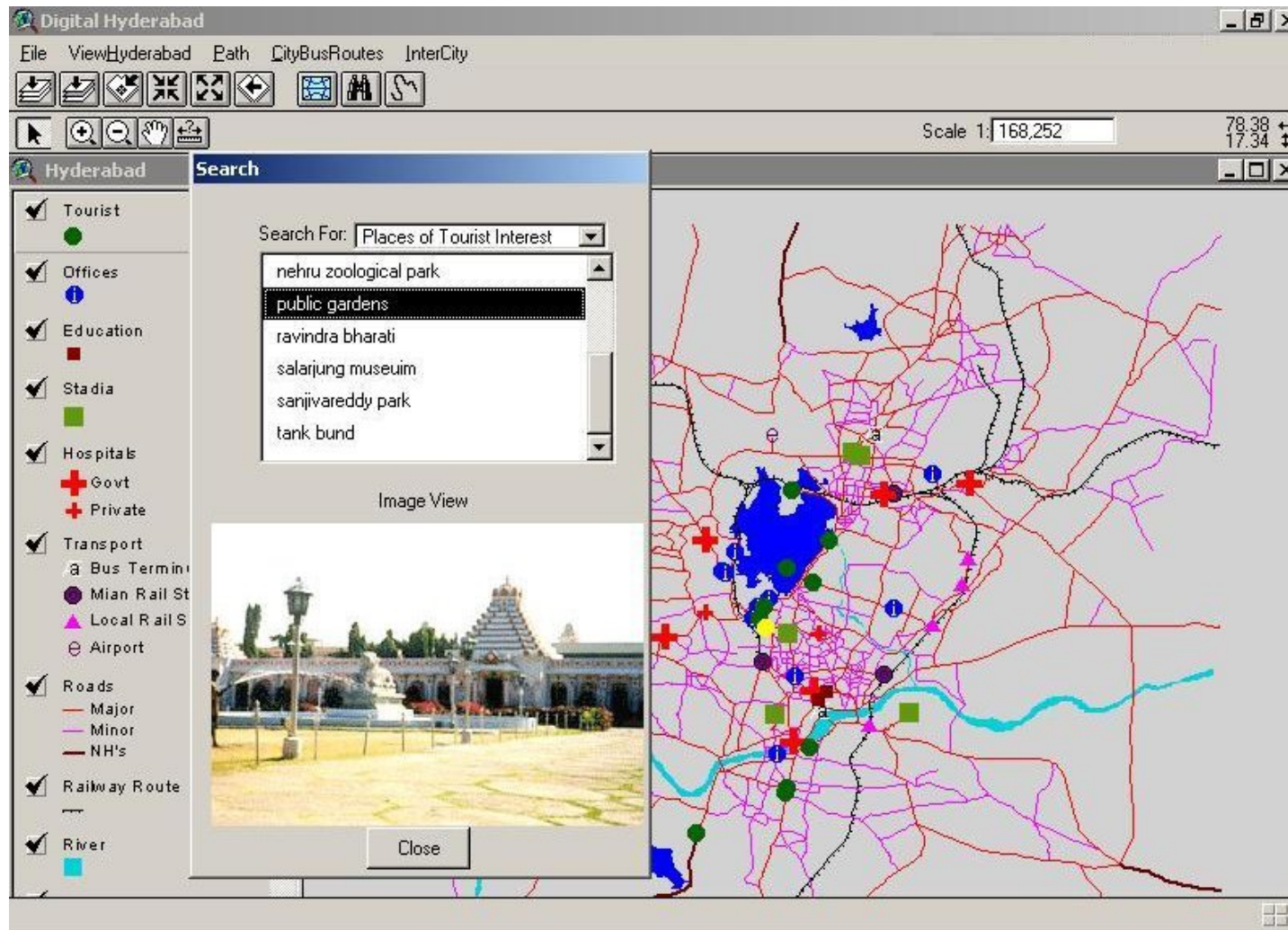
- Digital traveller information system for Hyderabad city had been developed.
- Network Analyst extension of ArcGIS is used to solve common network problems.
- Avenue programming language was used to customize every aspect of ArcView.

- Capabilities of software:
 - Tools for viewing Hyderabad by location wise.
 - Shortest path based on distance and drive time between given origin (O) and destination (D) .
 - Optimum path to closest facility from selected point 4. Optimum path for site tour will be displayed in yellow colour on the map and directions will be displayed in 'site tour' dialog;
 - Bus numbers, schedules and routes for metro liners or metro express and ordinary buses from a given origin and destination.
 - Inter-city railway and airline service details.

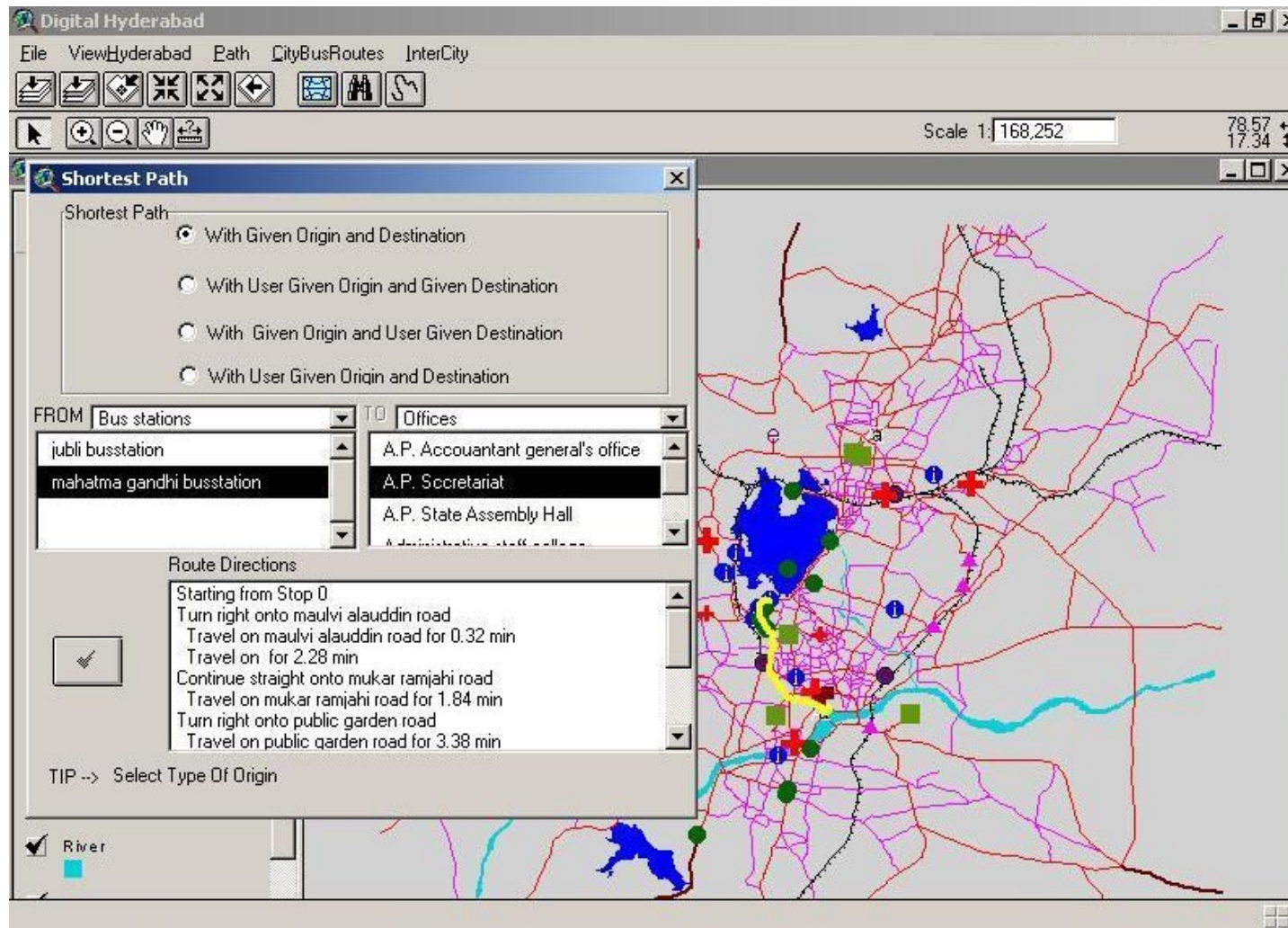
Location Wise View of Hyderabad



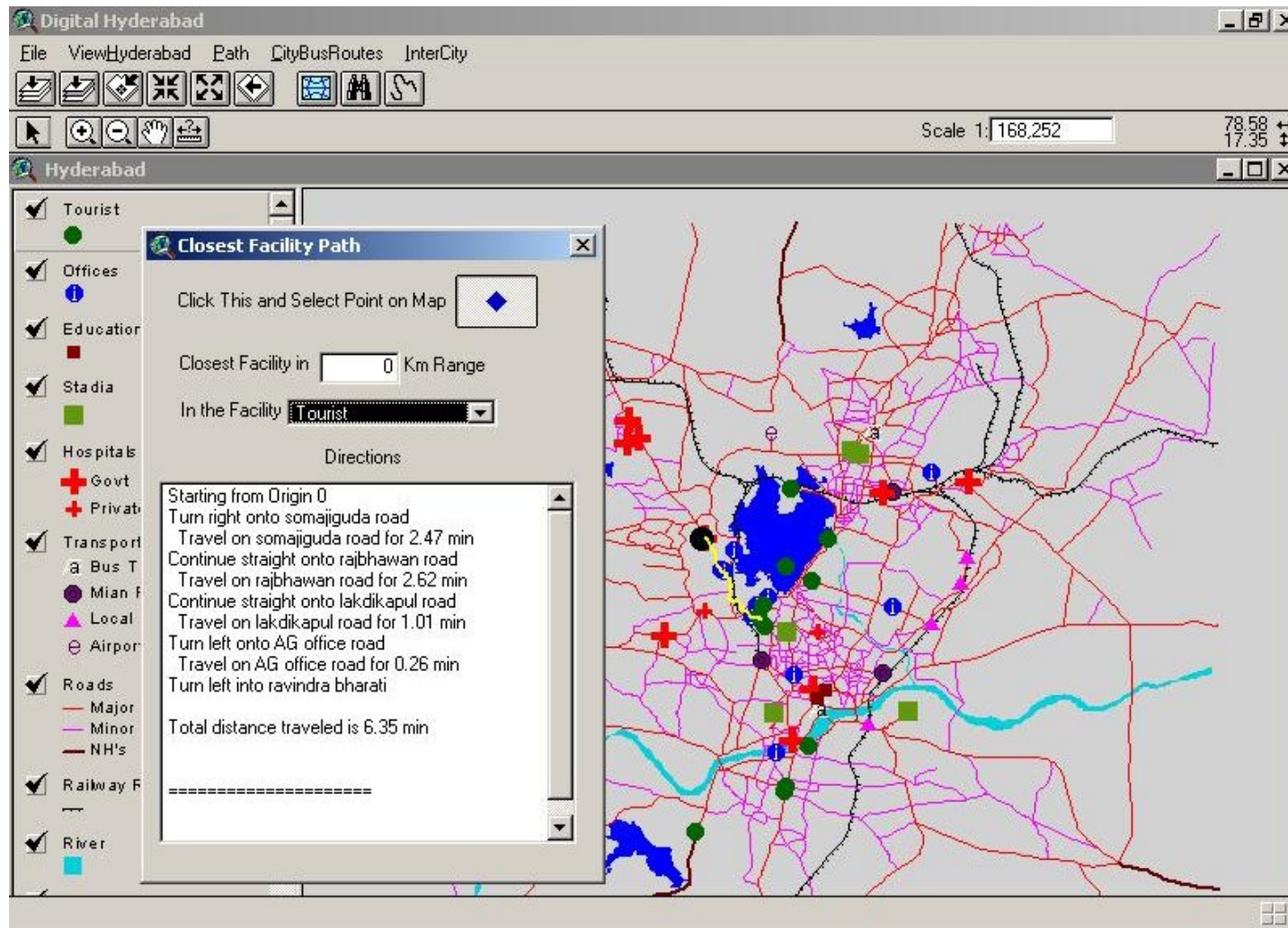
Searching for Features in Hyderabad



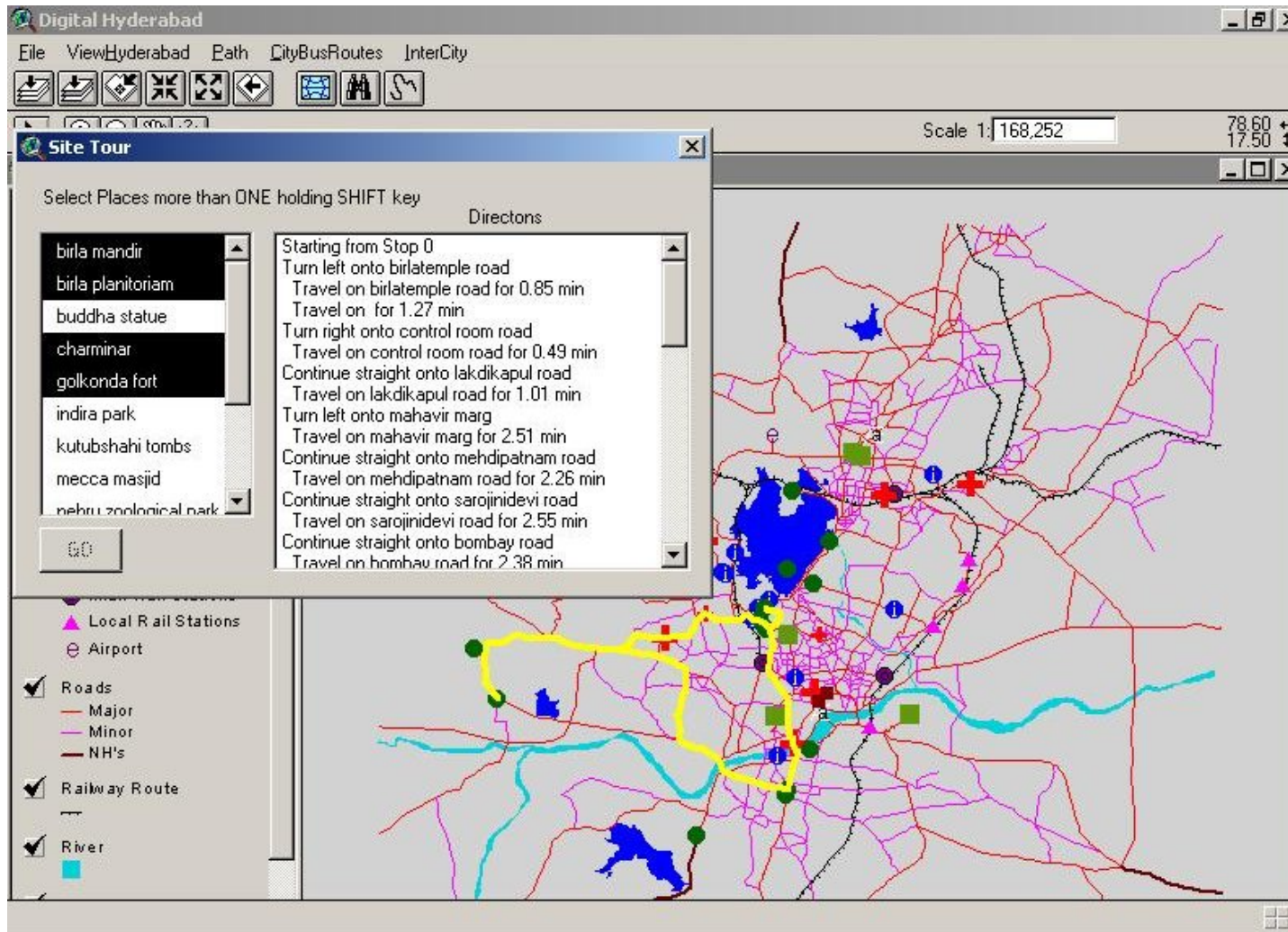
Searching for Shortest Path



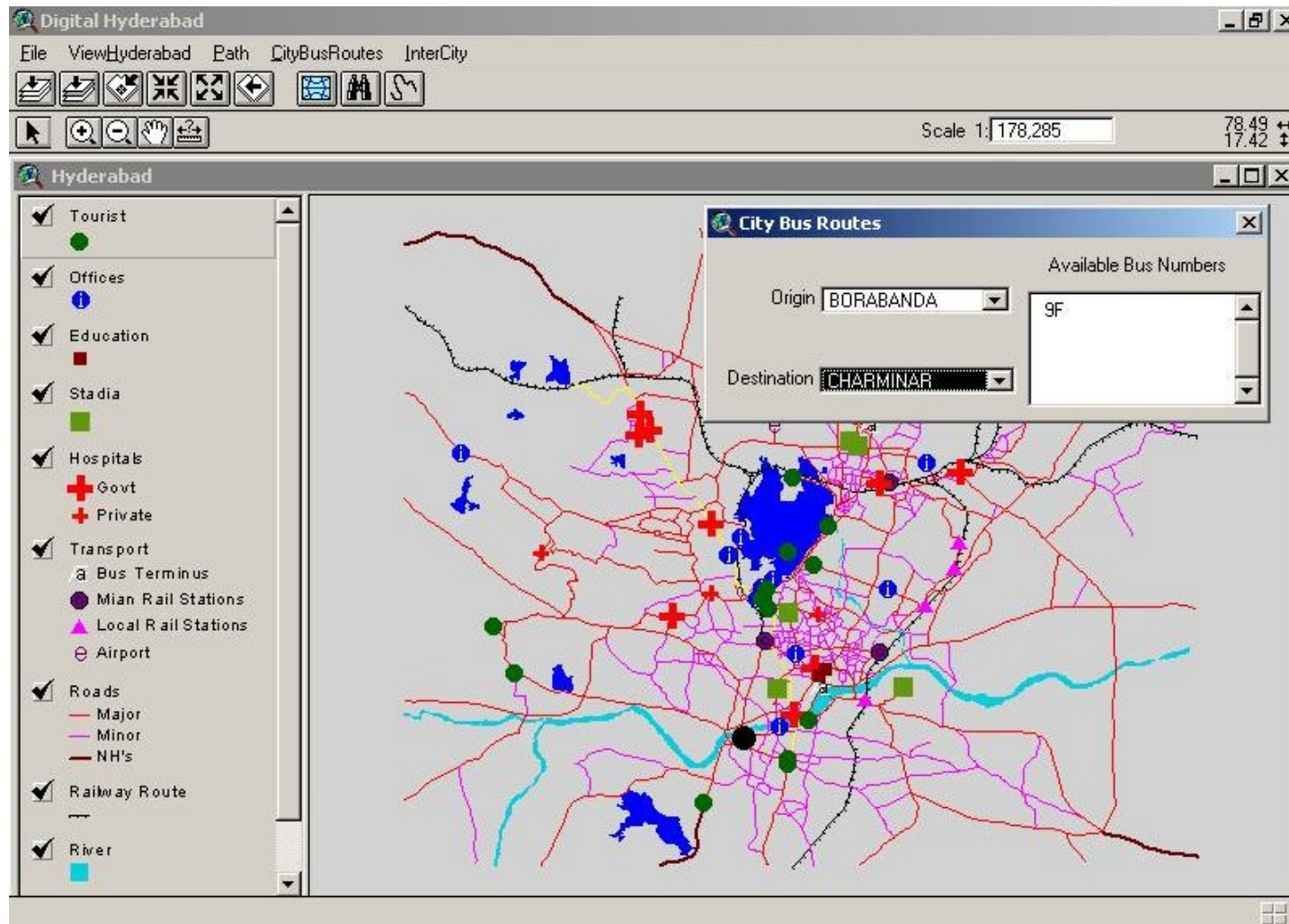
Closest Facility Path



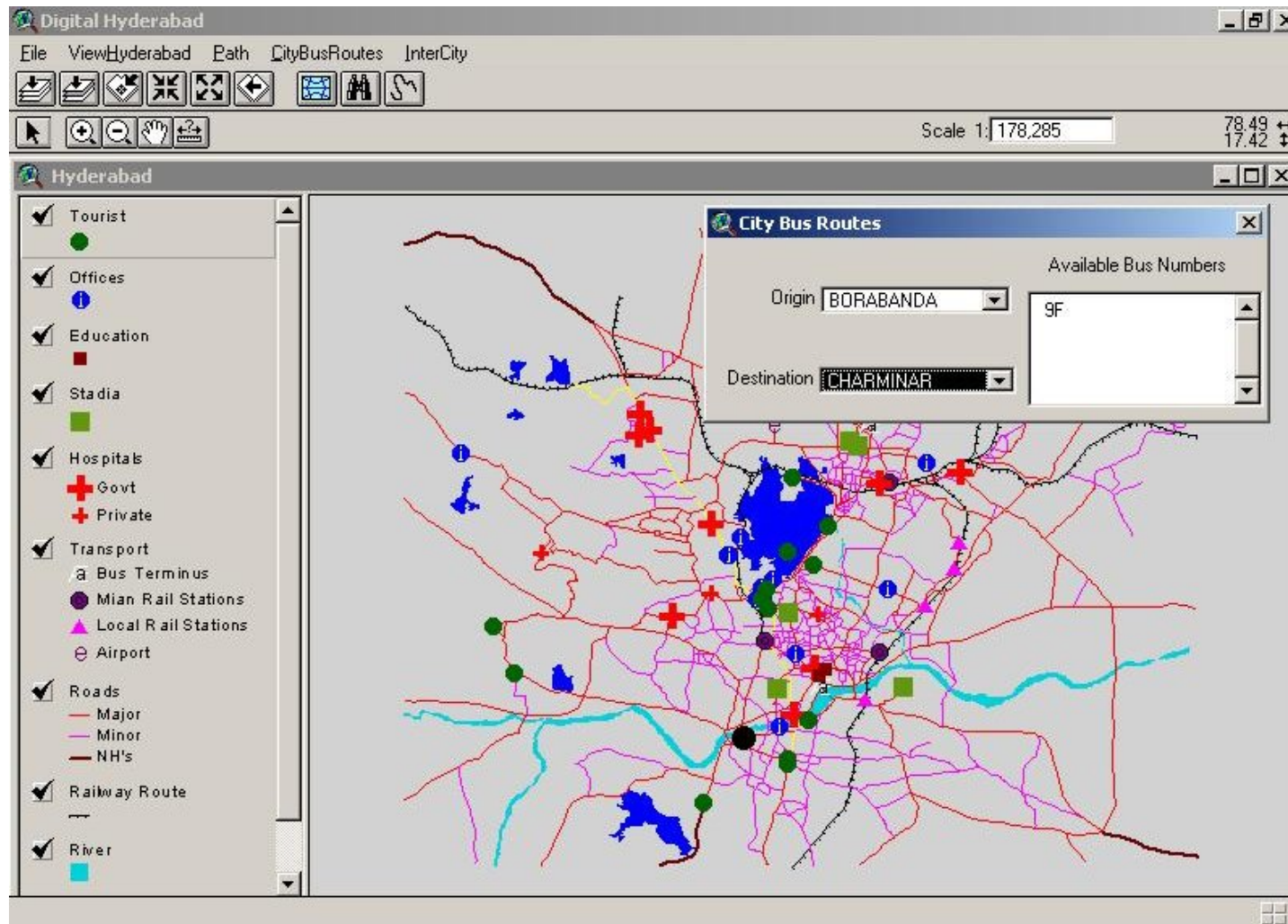
Site Tour



City Bus Services



Inter City Railway Services



1. Web based Advanced Traveler Information System for developing countries

- An ATIS namely Computerized Traveler Information and Decision Support System (CTIDSS) has been developed for structurally storing and analyzing the spatial and temporal data and disseminating the value-added traveler information using three-tier client/server architecture.
- Proposed ATIS uses the integration of World Wide Web (WWW) and Geographic Information System (GIS) so that powerful geo-spatial analysis capabilities of GIS can be utilized for generation of detailed traveler information and WWW as a global information dissemination source.

Software Used-

- Geomedia Professional for vector data generation from map through the processes of geo-referencing and digitization
- Microsoft SQL Server 2000 has been used for storing the spatial and non-spatial data
- Windows 2000 Server with Service Pack 4 is used as operating system
- Internet Information Server (IIS) as a web server
- GeoMedia WebMap Professional as GIS server

CTIDSS works in five basic information modules- Search Module, Traffic/Road Info Module, Network Module, Transit Module and Data Update Modules.

CTIDSS FOR DELHI

The screenshot shows a web browser window displaying the CTIDSS website. The browser's address bar shows the URL. The website has a yellow header with navigation links: Home, Search Features, Road/Taffic Info, Network Analysis, and Transit Information. A date and time stamp indicates the page was accessed on January 22, 2007, at 3:50:51 AM. On the left, there is a 'Do you know?' section with text about the system's capabilities and a login form with fields for 'User Name', 'Password', and a 'Submit' button. The main content area features a 'Welcome To CTIDSS!' message, a paragraph describing the system as an interactive web GIS based traveler information system, and a list of links: Search Features, Road/Traffic Info, Network Analysis, and Transit Information. Two images are included: a screenshot of the CTIDSS application interface showing a map with green lines and red dots, and a photograph of a busy street in Delhi. Annotations with arrows point to the top menu bar and the list of links, both labeled 'Hyperlinks to access different modules'.

Home | [Search Features](#) | [Road/Taffic Info](#) | [Network Analysis](#) | [Transit Information](#)

January 22, 2007 , Accessed at:3:50:51 AM

Menu bar with hyperlinks to access differents modules

Do you know?

CTIDSS enables you to locate closest available hospitals, hotels, places of worship, historical places and find route to reach them from your location. It helps to know about the congested roads one way roads, blocked roads.

For data update login here !!

User Name:

Password:

Submit

Welcome To CTIDSS !

Computerized **T**raveller **I**nformation and **D**ecision **S**upport **S**ystem (CTIDSS) is an interactive web GIS based traveler information system. It helps you to inquire about travel related information. CTIDSS provides you information through interactive and intuitive **G**eographic **I**nformation **S**ystems (GIS) enabled maps without the need to install GIS on your system.

Please click on links below (or on top menus) to know more about CTIDSS functions and their use

- [Search Features](#)
- [Road/Traffic Info](#)
- [Network Analysis](#)
- [Transit Information](#)

Hyperlinks to access different modules

Designed by [Varun Singh](#) at Dept. of Civil Engineering ,IIT Roorkee.

CTIDSS FOR DELHI

CTiDSS
Computerized Traveller Information & Decision Support System

[Home](#) | [Search Features](#) | [Road/Traffic Info](#) | [Network Analysis](#) | [Transit Information](#)

Do you know?

CTIDSS enables you to locate closest available hospitals, hotels, places of worship, historical places and find route to reach them from your location. It helps to know about the congested roads one way roads, blocked roads.

For data update login here !!

User Name:

Password:

Submit

January 22, 2007 , Accessed at:7:10:12 AM

Road/Traffic Info

This functionality helps you to know about traffic volumes on roads, one way roads work zones etc.

Select the type of viewer from the list. Viewer helps you to view and query GIS generated. Then Press **Submit!** button

JMapMap Viewer
ActiveDGM Viewer

Submit

CTIDSS FOR DELHI

CTIDSS

Home

Search Features

- Know About
- By Area
- By Selection
- By Query
- Locate Roads

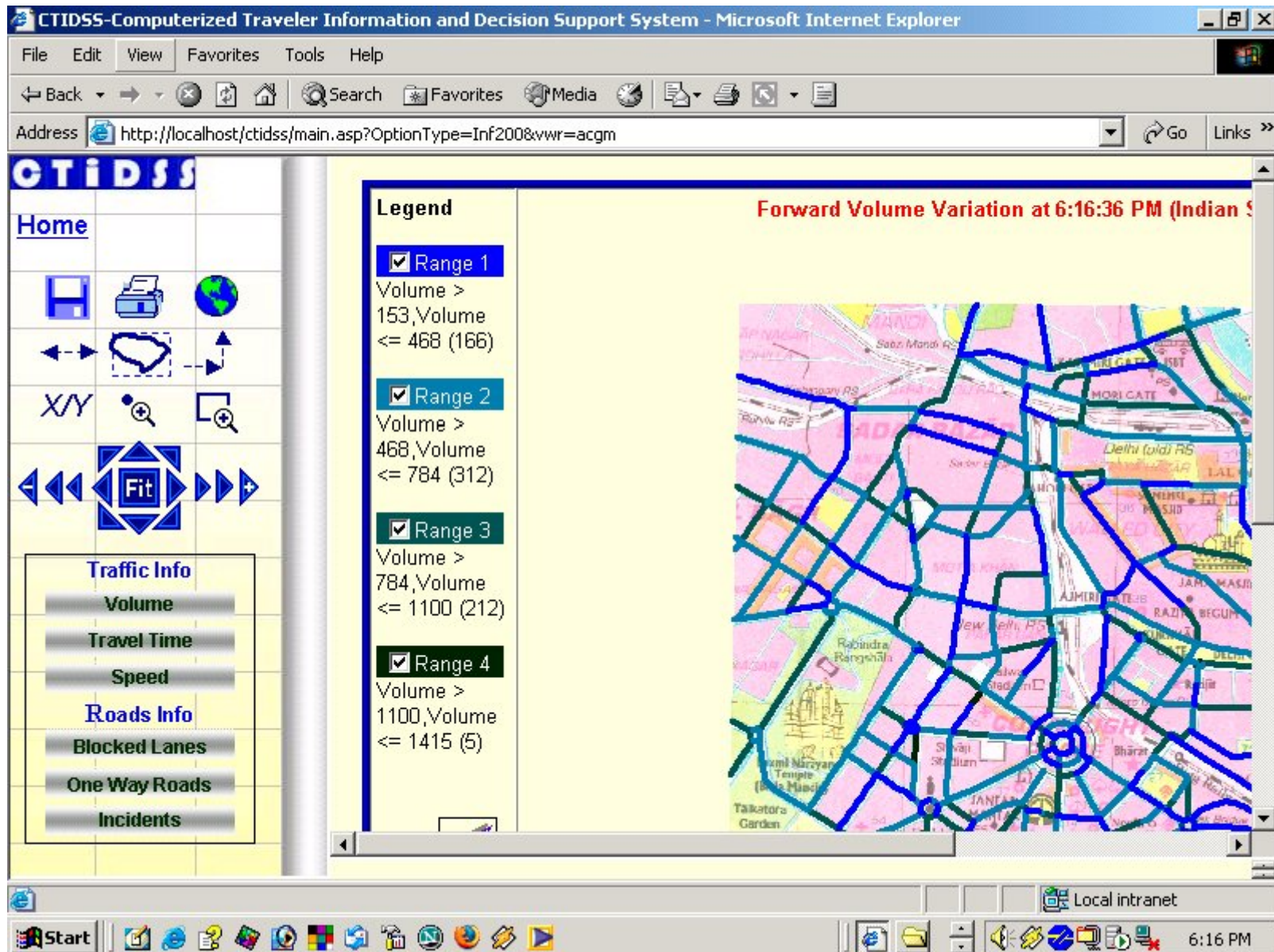
ID	Name	Type	More Information
3	Vigyan Bhawan	Auditoria	Click Here
21	Sapru House	Auditoria	Click Here

Processing...

Local intranet

8:56 PM

CTIDSS FOR DELHI



CTIDSS FOR DELHI

The screenshot shows the GeoMedia Professional interface with a table titled "Events" containing data on road blockage sections. The table has four columns: ID, BeginMarker, EndMarker, and Name. The data is as follows:

ID	BeginMarker	EndMarker	Name
1	100	1100	IndiaGate Hexagonal Road
2	300	600	Indira Chowk
3	1341.1	1720.6	Indira Chowk
4	967	1200	Mother Teresa Crescent Road
5	1127.1	1524.8	Mother Teresa Crescent Road
6	0	300	Sardar Patel Marg
7	400	530	Sardar Patel Marg
8	120	300	Teen Murti Marg

Below the table, the text "Events -Road Blockage Sections" is displayed in green. The software interface includes a menu bar (File, Edit, View, Insert, Tools, Analysis, Warehouse, Data, Window, Help), a toolbar with various icons, and a status bar at the bottom showing "Record: 8 of 9" and "1:31,591".

CTIDSS FOR DELHI

CTIDSS-Computerized Traveler Information and Decision Support System - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media Print Mail

Address <http://localhost/ctidss/main.asp?OptionType=Inf300&vwvr=acgm> Go Links

CTIDSS

Home

Network Analysis

- Shortest Path
- Closest Facility
- Analyze Route

Select the Direction report option by clicking respective 'View' button

Directions Report	View
Detailed Directions Report	View

Local intranet 5:03 PM

CTIDSS FOR DELHI

The screenshot displays the CTIDSS web application in a Microsoft Internet Explorer browser window. The browser's address bar shows the URL: `http://localhost/ctidss/main.asp?OptionType=Inf300&vwvr=acgm`. The application interface is divided into several sections:

- Navigation Menu:** Located on the left, it includes a "Home" link and a grid of icons for file operations (save, print, globe), navigation (back, forward, home, search), and zooming (fit, zoom in, zoom out).
- Network Analysis Panel:** A vertical panel on the left containing three buttons: "Shortest Path", "Closest Facility", and "Analyze Route".
- Map:** The central area shows a map of Delhi with a green network of roads and a red line representing a selected route. The route starts at "Stop 3" (near Jantar Mantar), goes to "Stop 2" (near Nehru Park), and ends at "Stop 1" (near Ring Road). Landmarks like Shivaji Stadium and Railway Stadium are also visible.
- Status Bar:** A red-bordered box at the bottom of the map area displays the text: "Total travel time on selected route 5.131 mins".
- System Tray:** The bottom of the browser window shows the Windows taskbar with the Start button, several application icons, and the system clock showing "11:08 AM" on "Local intranet".

दैनिक जागर

आईआईटी रुड़की ने तैयार किया एडवांस ट्रेवलर इनफारमेशन सिस्टम

'भटकों' को राह दिखाएगा 'जादुई चिराग'

महेश पांडे, रुड़की

आप कभी दिल्ली नहीं गए लेकिन अब एकाएक जरूरी काम निकल आया तो घबराइए नहीं, आप न तो दिल्ली में राह भटकेंगे और न गाहे-बगाहे ट्रेफिक जाम से रूबरू होंगे।

ये सब सहूलियत अलादीन का चिराग नहीं मुहैया कराएगा बल्कि देश की नामचीन आईआईटी रुड़की की ईजाद एडवांस ट्रेवलर इनफारमेशन सिस्टम (एटीआईएस) आपकी मदद को हाजिर होगा, जिसे आप अपने वाहन में लगा सकते हैं। मौजूदा

वाहन में लगने वाली यह डिवाइस बड़े शहरों से अंजानों की करेगी राह आसान

आने वाली मुश्किलों से पार पाने में मदद करे तो कहना ही क्या। इसी समस्या को समझते हुए इंडियन इंस्टीट्यूट आफ टेक्नोलाजी, रुड़की ने एक तकनीक विकसित की है जो आपके लिए किसी 'गाइड' से कम नहीं। यह तकनीक आपको सभी



Graphics : Yatendra

दौर की खासी तेज लाइफ स्टाइल में सबसे ज्यादा कमी है तो वक्त की और अगर ऐसा कोई सिस्टम, कोई डिवाइस हाथ आ जाए जो रोजमर्रा की भागदौड़ भरी जिंदगी में राह में

डिटेल्स, मसलन रास्तों, जाम, बस, मेट्रो व ट्रेन की समय सारणी आदि का ब्योरा कार में बैठे ही बता देगी। आईआईटी रुड़की के ट्रांसपोर्टेशन इंजीनियरिंग ग्रुप, सिविल डिपार्टमेंट द्वारा तैयार एडवांस ट्रेवलर इनफारमेशन सिस्टम (एटीआईएस) नामक

यह तकनीक इस वर्ष दिल्ली में आयोजित होने वाले कामनवेल्थ गेम्स में भी महत्वपूर्ण भूमिका अदा करेगी। इस साफ्टवेयर में रास्तों, ऐतिहासिक जगहों, हास्पिटल, होटल, बस

■ शेष पृष्ठ 2 पर

हैदराबाद, जयपुर और चंडीगढ़ के लिए भी तैयार

रुड़की: आईआईटी रुड़की द्वारा हैदराबाद, जयपुर, चंडीगढ़ के लिए भी यह तकनीक तैयार की गई है। इन जगहों पर भी जाम की समस्या से लोग जूझते हैं, जिसे देखते हुए हुए यह तकनीक बनकर तैयार हो गई है।

एटीआईएस के फायदे

- ☞ सुलभ रास्ते के बारे में देगा जानकारी
- ☞ पेट्रोल बचाने को बताएगा छोटे रास्ते
- ☞ आटो एवं टैक्सी का बताएगा किराया
- ☞ हर बेहतर फैसिलिटी की देगा जानकारी
- ☞ सहूलियत से कर सकेंगे दूर प्लानिंग
- ☞ बसों का नंबर के साथ बताएगा समय
- ☞ मेट्रो एवं ट्रेनों का किराया भी बताएगा
- ☞ ट्रेन टाइम टेबल का पूरा ब्योरा भी देगा
- ☞ होटल बुकिंग व पैकेज की जानकारी

'भटकों' को राह दिख

मेट्रो, ट्रेन, पेट्रोल पंप आदि का डाटा प जा रहा है कि जाम से निपटने में यह का वाहनों में फिट किया जाएगा। अगर सफर की समस्या होती है, तो तुरंत यह तक बताएगी। इसमें संबंधित स्थानों की दूरी, रहेगी। है न जादुई चिराग, न राह भटकेंगे समय। आईआईटी रुड़की के प्रोफेसर व कुमार बताते हैं कि यह इंटेलिजेंट ट्रांसपोर्ट। दो तरह की जानकारियां होंगी। पहली स्टे जानकारी होगी, जो चेंज नहीं होगी। दूसरी एवं भीड़ की डिटेल्स होंगी, जो पल-पल कि अंजान व्यक्ति भी कार में बैठकर ही जानकारी ले सकता है क्योंकि इनके बारे संबंधी डाटा फीड किया गया है।

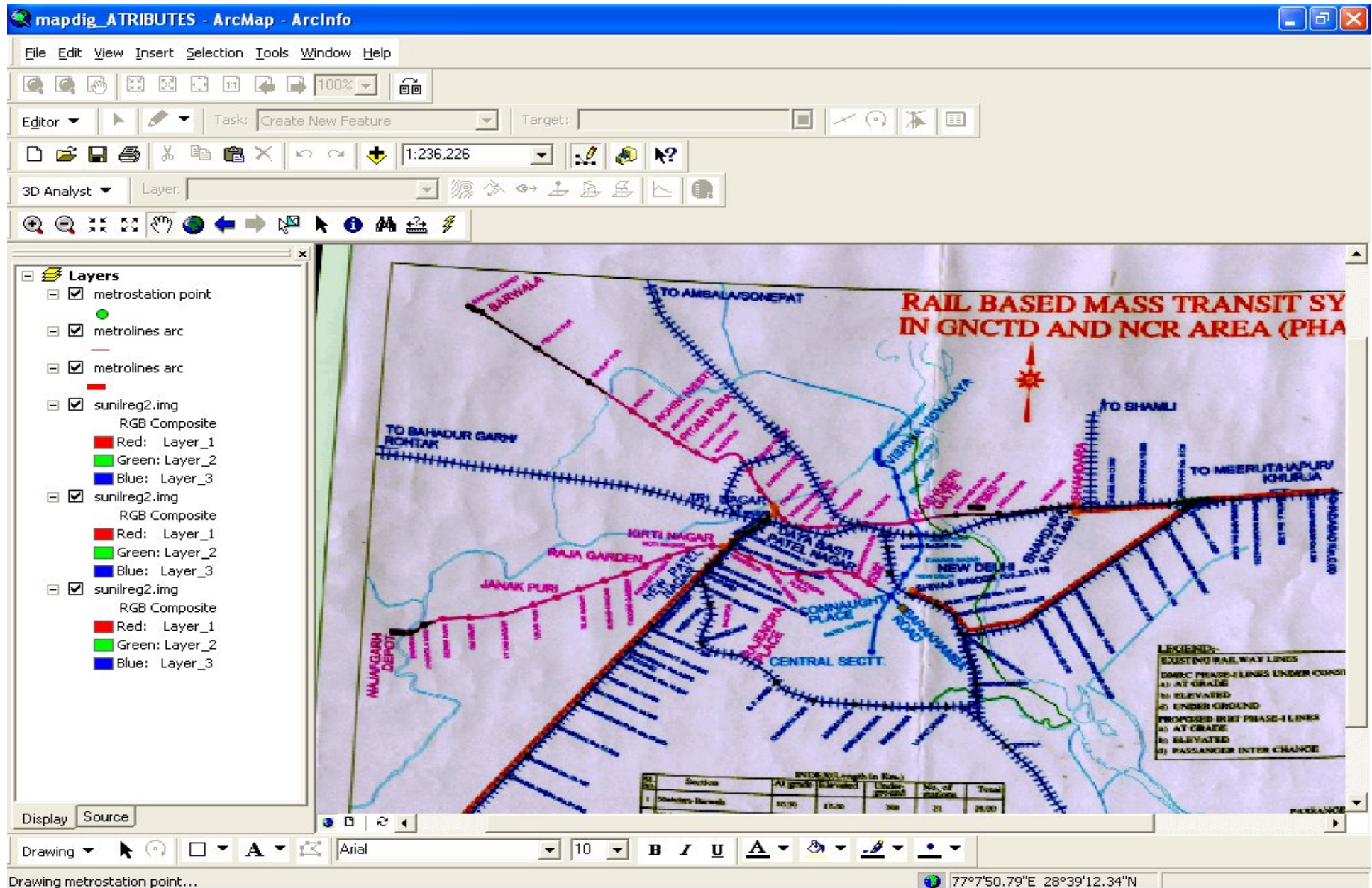
METRO RAILWAY

3. ITS for Delhi Metro Railway

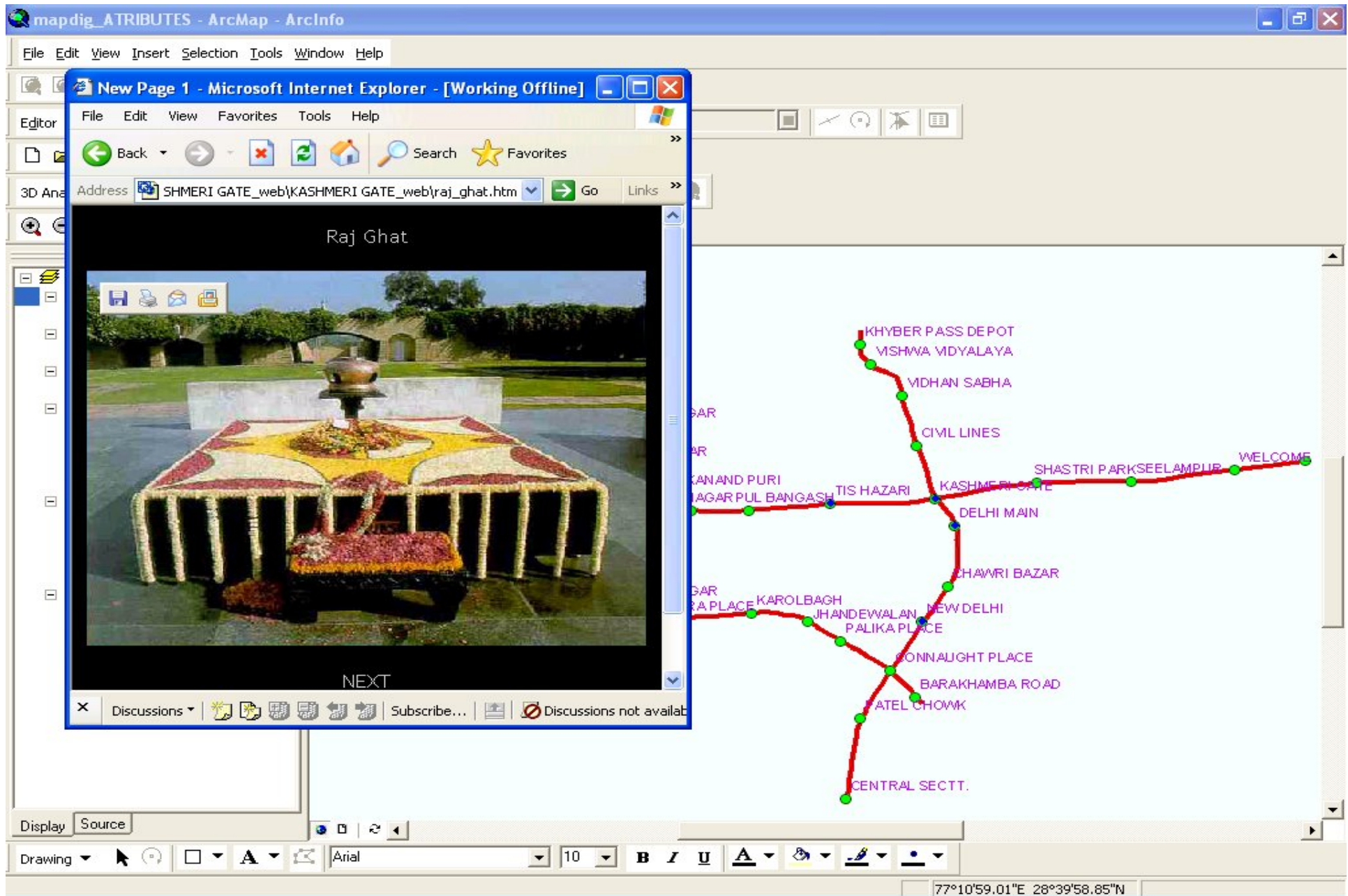
- Traveller information system for Delhi metro railway had been developed in GIS.
- Data was collected in form of maps, which include network map of DMRC and Delhi Tourist Guide map.
- Software Used:
 - ARC GIS 8.1 has been used for spatial data development and querying.
 - Microsoft front page has been used to hyperlink various visiting places of Delhi in ARC GIS.
 - Adobe Photo Shop has been used for enhancing photos to be used in HTML design.
 - Visual Basic Programming Language 6.0 has been used for programming and customization.

5. Multi Modal Advanced Traveller Information System for Delhi Metro Railway

- This work is an attempt to develop ATIS for Delhi metro.
- ArcGIS 8.1 is used to generate maps and spatial databases.
- HTML Image Mapper 3.5 is used to convert maps to interactive maps.
- Visual Basic 6.0 is used to develop a complete GUI application that works along with ArcGIS.
- Web side GIS application is designed by HTML Image Mapper and Client side application by java scripts.



Digital map with back ground



Using HTML Hyper Linking - Monuments

Smoke

into effect the ban
tobacco products
orning

drive being launched and teams to be contacted on offenders," he said, pleading anonymity. It has been eight weeks since the central government made it mandatory on manufacturers of tobacco products to carry pictorial warnings but bidi and gutka companies continue to flout the rules, says a study by the Voluntary Health Association of India (VHAI). Dr Ajay Dewan, senior surgeon and oncologist, Rajiv Gandhi Cancer Institute, Delhi, and Ganga Prem Hospice, Rishikesh, said with low levels of literacy, pictorial warnings with pictures of rotting gums could effectively warn bidi and gutka users, but the government must maintain regular checks.

Tobacco causes leukoplakia, white patches in the mouth, submucous fibrosis and trismus, inability to open mouth.

The use of tobacco can cause cancer, TB, chest infection, infertility and in pregnant women may lead to low birth-weight babies.

"Bidi brands have been violating the rules and have not placed pictorial health warnings. Many

IIT devices info system for travellers

- Provides directions on the best path and closest facility based on distance and travel time
- Calculates auto/taxi fare and travel time
- Displays available facilities along the path
- Provides common GIS functions like feature display, zoom
- Provides bus route info and Delhi metro fares
- Provides info on departure time, days of operation and important stops for each train

AKASH GHAI
TRIBUNE NEWS SERVICE

ROORKEE, AUGUST 2

In an effort to make the country's capital more commuter-friendly, the Indian Institute of Technology, Roorkee, has developed the Advanced Traveller Information System (ATIS).

According to experts at IIT, the system would prove useful if put into place before the forthcoming Commonwealth Games, which are slated to be held in New Delhi in 2010.

Dr Parveen Kumar, principal investigator of the project, transportation engineering group, civil engineering department, said the demand for transport facilities has been growing worldwide.

"In today's fast-paced lifestyle, people need to get to their destinations swiftly, safely, reliably and

Parveen said the ATIS for Delhi has been developed in advance GIS softwares, which can be installed in any computer system and can be used in any vehicle.

Complete information about the city such as road network, historical places, hospitals, hotels, auditoria, petrol pumps, buses, metro, and railway stations has been provided in this custom application.

The system, based on two types of information - static (which is known in advance and rarely changes) and realtime (which changes frequently), - displays the best path between

an origin and destination or a set of places, paths to closest facilities on map and also provides path directions based on distance and travel time.

Information regarding city bus routes, Delhi metro train fare and frequency, interstate bus services and inter-city trains has also been included in the application.

The system can prove useful if put into place before the forthcoming Commonwealth Games to be held

- System has the following capabilities:
 - Tools like pan, zoom in, zoom out, shortest path between locations based on road length, metro information, finding and identifying features
 - Identify tool to get basic information of various features
 - Find feature to get information regarding a specific place
 - Shortest path by means of utility network analyst GIS functionality
 - Information about transport facilities (Schedule, fare, route, etc.)
 - Attribute view of feature

8. Advanced Traveller Information System For Jaipur City

- The ATIS for Jaipur city is created using ArcGIS 9.3
- The system provides following for city Jaipur:
 - Complete information such as road network, historical places, hotels, auditoria, art galleries, museums, and bus and railway stations.
 - Information regarding city bus routes
 - Information about tourist places
 - With the help of 'Network Analyst' tool of software one can find shortest path between set of origin and destinations, closest facility and facilities available within given distance or time selected as impedance.

Fig 14 Information of Tourist spot with Image of Place

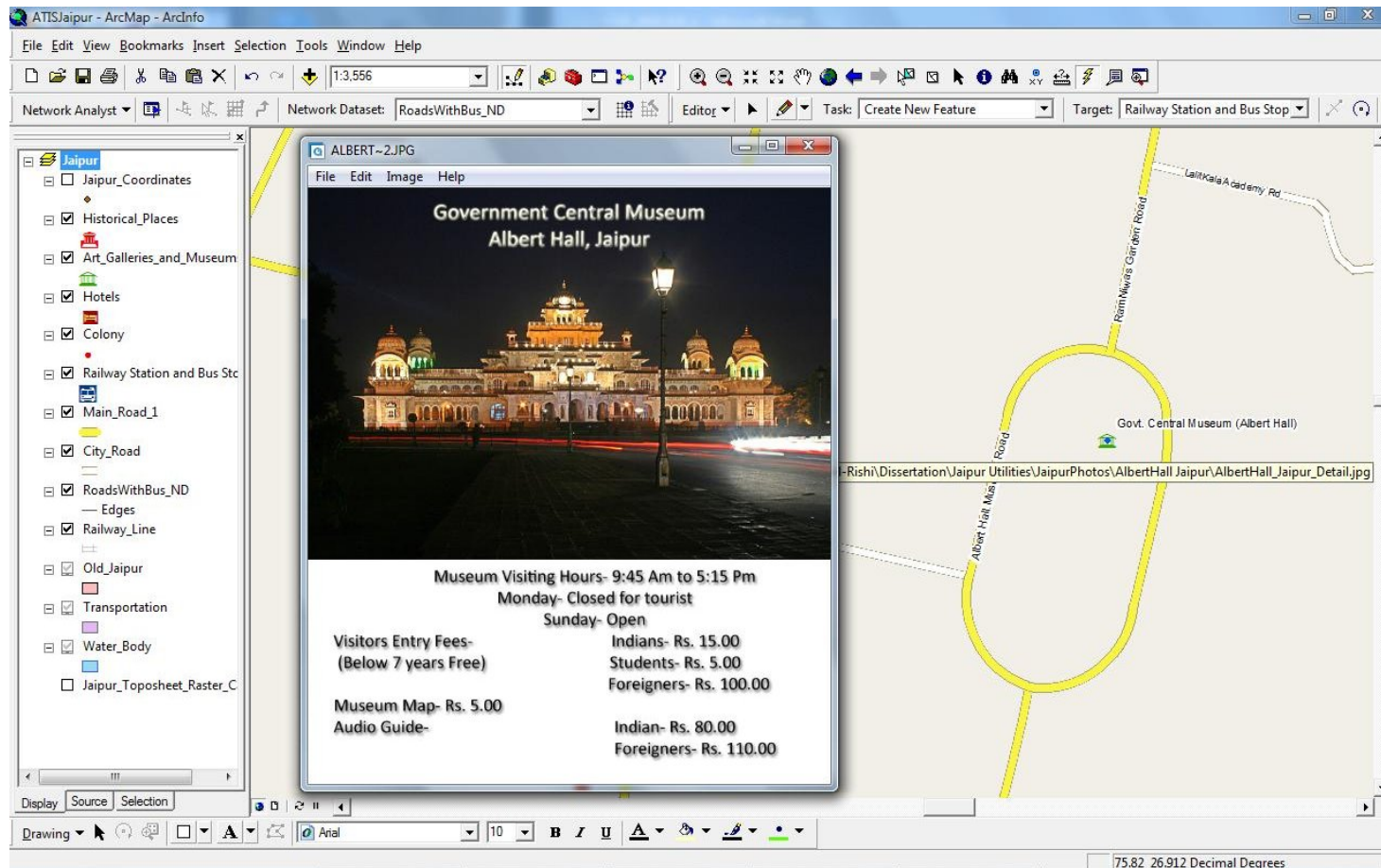


Fig 16 Railway Station to Hotels within Specified Distance or Time

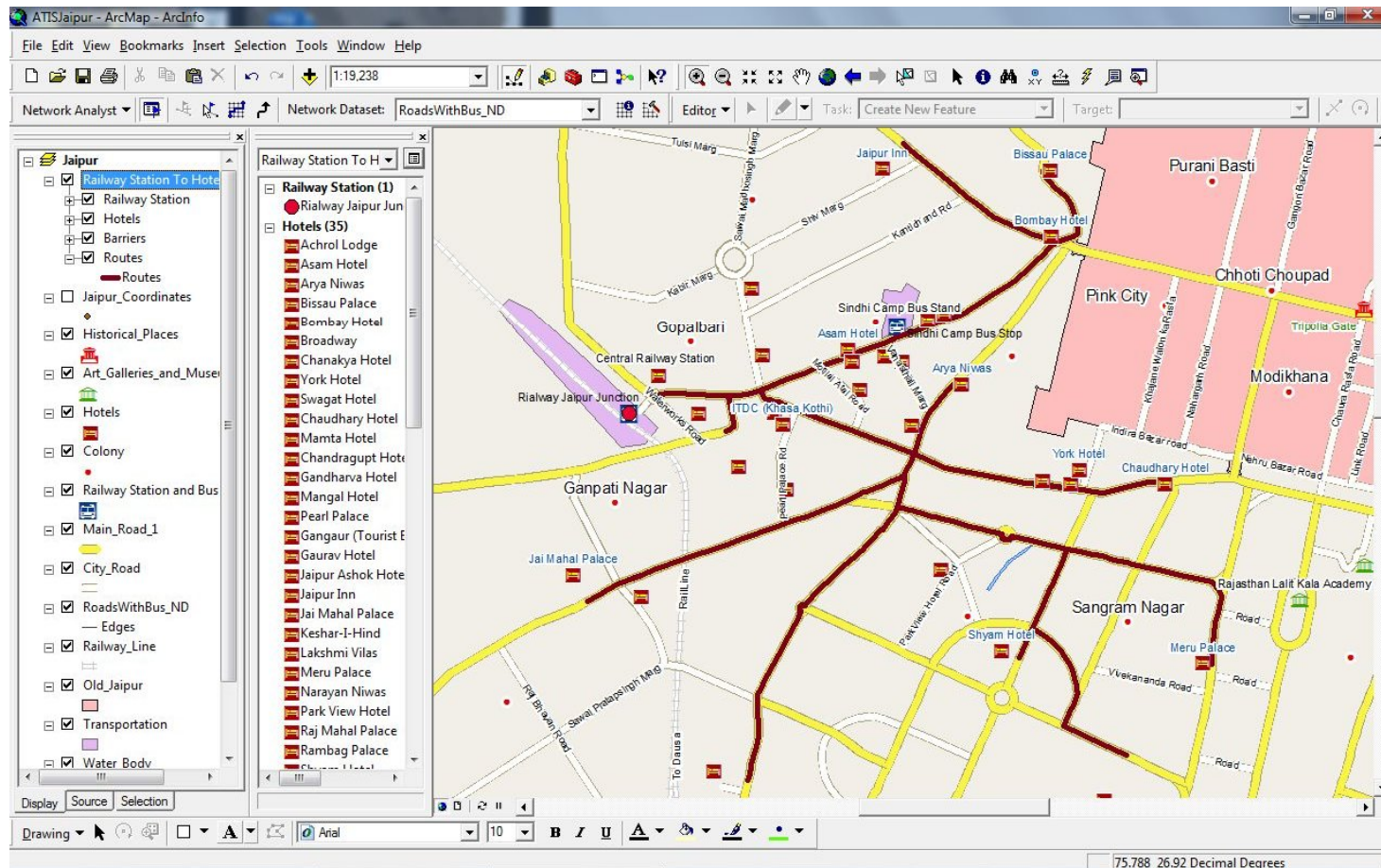


Fig 19 Routes Planning for Multiple Stops

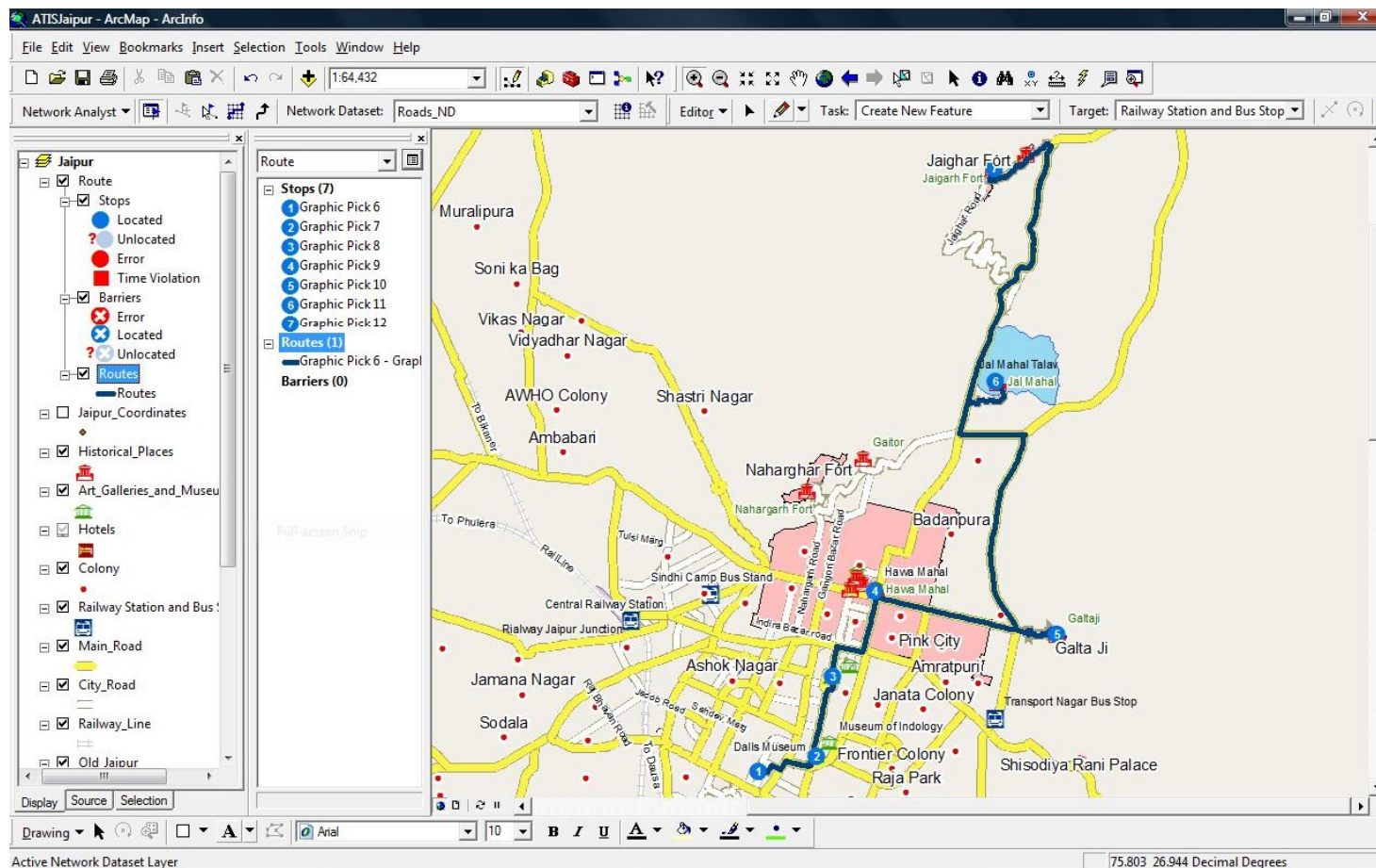
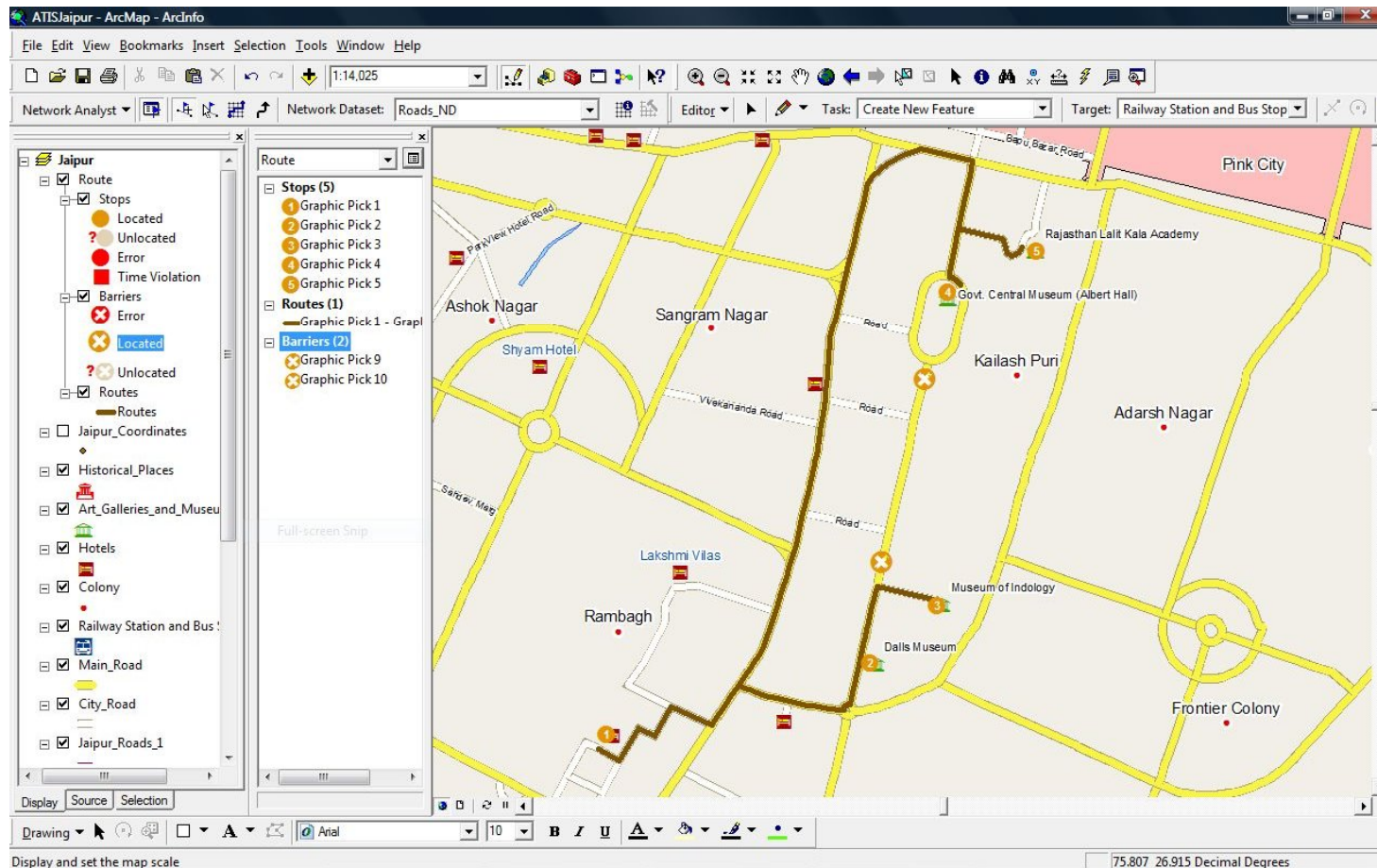


Fig 20 Alternative Route from Origin to Destination with Constraints



ATIS CHANDIGARH

- Peak hour smoothening by ANT algorithm
- Display Boards on Road and Inside Bus
- Ticketing System
- Online seat information using GPS

Application of ANT Administrative System in Web GIS Based Advanced Public Transport System



Ant Colony



Bird Flock

Fish School

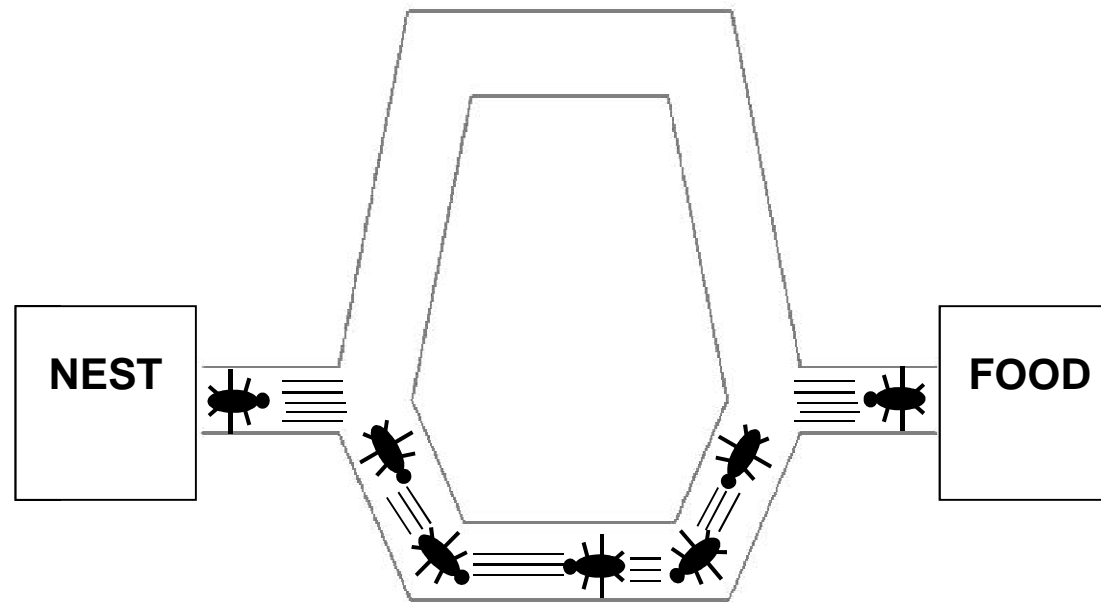


Animal Herd



- French entomologist Pierre-Paul Grasse in the 1940s and 1950s, discovered that the insects (termites) were capable to react to “significant stimuli” signals.
- Deneubourg et al. (1990) set up an experiment called a “binary bridge experiment”. The ants' nest was connected to a food source by two bridges of equal length.

The more ants follow a trail, the more attractive that trail becomes for being followed because of its pheromone intensity



6. Public Transportation Systems with ITS technologies

- A Web GIS based Advanced Public Transport System (APTS) is developed through internet.
- Capable of disseminating the functionalities of both Advanced Traveler Information System (ATIS) and Ticketing System.
- The three tier logical architecture selected.
- Ticketing System for ticketing operation through internet and its integration with Global Positioning System (G.P.S.) for acquiring real time bus position data.
- ATIS for providing the spatial data query facility and Vehicle Location System (AVLS), capable of displaying the real time bus positions over a spatial map.

- The ATIS system also provides the functionalities to find out the shortest route between the two selected origin and destination points using Ant System Algorithm in a Web GIS environment.
- UMN MapServer along with Internet Information Service (IIS7) in Application tier was used as map and web servers.
- City Chandigarh is selected as the study area
- ERDAS IMAGINE and ArcGIS 9.3 for spatial data development.
- SQL Server Management Studio Express is used for database development for storing information.
- Web pages for providing the various functionalities of the system modules are designed in the C# ASP.NET framework of the Microsoft Visual Studio .NET 2008

7. Application Of Ant Administrative System In Web GIS Based Advanced Public Transport System (APTS)

- Ant Administrative system developed as a part of web GIS based APTS is a system that helps the officials of the public transport in designing the bus routes as per the travel behavior observed.
- Ant algorithms take inspiration from foraging behavior of ants.
- Public transport system of a city has predefined bus routes and decided frequency of the buses on those particular routes.

- The travel behaviors of the travelers changes with time depending upon the infrastructure development, population growth and their varied travel needs.
- Therefore a system that can design the bus route in an optimum way to serve according to the users need.
- The Ant Administrative System uses ticketing data of buses for assigning weight to the links.
- It is assumed travellers always prefer travelling from shortest route, shortest route were found out between each Origin Destination pair.
- Each link used in the shortest route of any trip will be having a Weightage factor and the links that were not used in the shortest route of any trip will be having a Weightage factor as zero.

- The main page of AAS has three panels- Data Panel, Weightage Panel and Bus Route Panel.
- List of the shortest routes that are satisfied by the designed bus route and their associated numbers of trips that are satisfied by their shortest path along with economic ratio (number of trips satisfied per unit length of the designed bus route) can be found out.
- After varying different parameters the bus route that satisfied the maximum trips in an economical bus route length can be accepted.
- The system is able to design the bus optimum routes in such a way that the maximum numbers of trips expected in the network of public transport can be served by the their shortest route with a considerable economical ratio.

IIT experts have a plan for better public transport

AKASH GHAI
TRIBUNE NEWS SERVICE

CHANDIGARH, JANUARY 6

Taking a cue from ants, the Indian Institute of Technology (IIT), Roorkee, has come up with a solution to streamline the public transport system in the city.

According to it, while Chandigarh Transport Undertaking (CTU) buses on certain routes are overloaded, buses ply almost empty on some routes at the same time. The best way to streamline traffic is by striking a balance between the overloaded and the empty buses.

The IIT, Roorkee, has developed a web GIS-based advanced public transport system (APTS) using the ant algorithm system.

"Ants always choose the shortest path. This is known as ant algorithm. This algorithm, which is being used worldwide, has been chosen for making appropriate number of buses ply on all routes in Chandigarh so that there is no overloading in buses on certain routes," said Dr Parveen Kumar, Professor of Civil Engineering at the IIT, Roorkee, and his student Dr Sanjeev Suman, who have come up with the idea.

Giving details about the system over the phone, Dr Parveen Kumar said the system, called the Ant Administrative System, had



A FILE PHOTO

ANT ALGORITHM

Ants always choose the shortest path. This is known as ant algorithm. This algorithm, which is being used worldwide, has been chosen for making appropriate number of buses ply on all routes in Chandigarh so that there is no overloading in buses on certain routes.

— DR PARVEEN KUMAR, PROFESSOR, IIT, ROORKEE

the ant algorithm.

"The most important module of the APTS is the ant algorithm-based decision support system for public transport management officials. The decision support system helps management officials make better decisions regarding the operational aspects of the public transport system. The goal of the decision support system is to provide public transport decision makers more information to make effective decisions to increase commuters' convenience," said Dr Parveen Kumar.

He said the system involved the use of the intelligent transport system, the geographical information

tioning system.

"This is basically a methodology developed for the city after a thorough study of all aspects. If required, it can be applied to other big cities in the country after collecting data," said Dr Parveen Kumar, adding that it made the transport system more efficient and reduced the operations cost.

The experts have also designed certain routes in the city in their work, which would be presented in the forthcoming annual session of Indian Roads Congress, scheduled to be held at Coimbatore (Tamil Nadu) on January 9. About 2,000 road engineers from different parts of the country are like-

9. Ongoing work for Indore City of Madhya Pradesh

- An ITS architecture is being developed for a medium sized Indian city, which includes functionality of Advanced Traveler Information System and Intelligent Incident Management System
- Travellers can access, analyze and query the spatial and non-spatial data in a Web GIS based environment
- ATIS can find shortest route between two points using both length and travel time as impedances.
- Getting Alternate route during emergency and update of accidents and other incidents at central database is done under Incident Management Module.

- Spatial data including bus stops and bus route data, points of interests (public utilities), Google Map of Indore and all roads of Indore is collected from Atal Indore City Transport Services Ltd (AICTSL).
- Ground data which includes travel time data is collected on major routes of Indore with both private and public mode of travel.
- Ticketing data of the ibus for a month is collected from AICTSL office. This data is formatted in form of origin destination data to know desire lines of travel.

- Accident data of the city is collected for last three years (2014, 2015 and 2016).
- The Accident data of Indore City and other spatial data has been developed in ArcGIS.
- Black spots of the major routes has been identified where more than 2 accidents occurred in month.
- These black spots and other points of heavy congestion have been digitized so that alternate routes can be calculated through Network analyst extension of Arc GIS in case of emergencies.
- Apart from this network analyst also allows to know the nearest police stations and hospitals in case of emergency.

Software used:

- ArcGIS is used for Geo-referencing and digitization.
- ArcGIS network analyst is used to solve a variety of problems based on geographic network.
- Further this extension is used for shortest route calculations based on historical traffic data so that one can get shortest route date and time specific.
- SQL server management studio is used for development of database.
- Visual Studio is used for designing website for ATIS, for publishing ArcGIS data to web and for coding of Ant Algorithm.
- Ant system algorithm is also used for finding shortest route with varying impedances. At first length of the link is used as impedance, than travel times (peak flow time, normal flow time and free flow time) which were collected are used as impedance.
- The work is still in development stage.



CONCLUSIONS

- ITS systems can play a major role in improving transportation system operation, particularly where traffic and junction delays impact on bus service speed and reliability.
- ITS systems for local transportation can be readily implemented with existing technologies.
- WWW based architecture namely three-tier client/server architecture can be suitably utilized for developing an ATIS for developing countries.
- ATIS have emerged as worldwide solutions for handling the transportation problems. Developing countries can also use these systems, but they have to consider their socio-economic conditions.
- Since the ATIS is specific to the geographical location, GIS can be effectively utilized to extend the capabilities of ATIS available through Web.

- The packages developed above are user-friendly with graphic user interface and the following capabilities.
 - Routing based on distance and travel time.
 - Displays various available facilities.
 - Helps in tour planning.
 - Provides common GIS functions.
 - Provides city bus route information between two places and also other modes of travel.
 - Provides fare, distance & timings for public transport users.
 - Can give alternate route in case of emergencies.
 - Useful for traffic management officials in planning of optimal bus routes and for incident clearance.

- Use of Open Source Software (OSS) in the development methodology for the public transport system represents an economical design .
- The three tier Logical Architecture is found suitable for providing GIS capabilities to the user over internet.
- Ant System algorithm is found suitable for route assignment within a city.
- These developments can be converged into a methodology, which is geographically transferable, and can be used for analysis of spatial data and network analysis, network design and information dissemination under Web GIS for any urban area in developing countries.



THANK YOU