

## **e-Pathai GIS (Electronic Project, Administration, Traffic, Highway Assets and Information management system) in Tamil Nadu Highways**

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### **Abstract:**

Transportation network is the backbone of Tamil Nadu for developmental activities. Tamil Nadu Highways Department (TNHD) is primarily responsible for construction and maintenance of the vast existing road network along with its voluminous data on existing roads and related infrastructure. There is a need for continuous monitoring and management of this road network to make quick, reliable and rational decisions because it is a complex task influenced by various factors such as traffic growth, axle loading, environmental impacts, socio-economic changes and availability of funds. Tamil Nadu Highways Department (TNHD) has already established a web based Road Maintenance Management System (RMMS). RMMS being only a database on road & bridge related data can generate a variety of reports but lacks visualization capabilities. As it is rightly said, “a picture is worth a thousand words” and “maps speak subtle and surprising truth”, TNHD rightly envisioned an e-Pathai (Electronic Project, Administration, Traffic, Highway Assets and Information management system) GIS, a Web based bi-lingual GIS to assist and rationalize decision making in planning, programming, funding, procurement and allocation of resources in road network in order to make the best use of public funds in preserving the road network at an acceptable level of serviceability. The system will also improve the technical capacities, skills and management capabilities of Tamil Nadu Highways Department (TNHD) and other related agencies associated with road management and maintenance thus improving the ability to manage efficiently and cost-effectively road maintenance and improvement activities.

The system consists of RMMS data collected using Advanced Data Collection Equipment (ROMDAS) and a mix of digital maps of Tamil Nadu consisting of several layers compiled from different sources such as Survey Of India, National bureau of Soil Survey and Land Use Planning, High resolution satellite imagery and attribute data on roads, bridges etc collected through departmental staff and also other attribute data of interest such as demographic details from Census of India, average annual rainfall data from India Meteorological Department. The web GIS system is dynamically linked to RMMS database and P&FMS (Project & Finance Management System) database which means the latest data on roads and bridges as and when updated in RMMS is available for query, analysis and reporting in the e-Pathai GIS. The Web GIS has been built using Esri ArcGIS for Server (Advanced Edition), Microsoft Silverlight, and Microsoft .NET framework supported by a set of powerful customized query and analysis tools developed specifically for TNHD.

The e-Pathai GIS is based on client-server architecture with the main part of the application on a centralized server and any user across the globe can use or access the server application after authentication using a client software i.e., browsers like Internet Explorer, Mozilla Firefox, etc.

**Keywords:** Tamil Nadu Highways Department (TNHD), Road Maintenance Management System (RMMS), Geographic Information System (GIS), Global Positioning System (GPS), Project & Finance Management System( P&FMS), e-Pathai GIS- Electronic Project, Administration, Traffic, Highway Assets and Information management system.

### **About the Author:**



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Master degree in Transportation Engineering & Management and Post Diploma in System Analysis and Data Processing. Working in Tamil Nadu Highways Department for more than three decades and served in planning, designing and project management. Immensely contributed towards the development of Information Technology (IT) in the department. Ily Initiated and successfully completed web enabled Road Maintenance Management System, Road Accident Data Management System, GIS, Project & Finance Management System. Held the post of Chief Information Officer (IT) from 2002 in Tamil Nadu Road Sector Project funded by World Bank and currently heading the IT Cell of the department.

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## Introduction

Transportation network is the back bone of all developmental activities in the state of Tamil Nadu. With exponentially increasing motorized vehicles there is always an ever increasing need for supporting road and related infrastructure. There is a need for continuous monitoring and management of this vast road network to make quick, reliable and rational decisions on upgrade and maintenance. Road network maintenance and management is a complex task influenced by a variety of factors such as traffic growth, axle loading, environmental impacts and availability of funds. It includes a number of diverse activities such as assessment of current and future needs for maintenance, rehabilitation, upgrading and geometric improvements. The task of setting a realistic complex criterion to decide which roads to repair on priority has today become more difficult with limited funds for road maintenance and an ever increasing road network and the related voluminous data on roads. The Tamil Nadu Highways Department (TNHD) primarily responsible for construction and maintenance of roads has a vast existing road network along with its voluminous data on existing roads & related infrastructure. In order to keep abreast with technology, TNHD established a web based Road Maintenance Management System (RMMS) consisting of a database on the condition and related data of each road collected through specialized data-collection vehicles. RMMS consists of a web enabled Road Information System and PMS - a planning system for prioritization of roads to suit the budget. RMMS being only a database on road & bridge related data can generate a variety of reports but lacks visualization capabilities. As it is rightly said, "a picture is worth a thousand words" and "maps speak subtle and surprising truth", Geographical Information System (GIS) is the right solution to enhance the analytical, problem-solving, and decision-making capability of TNHD. A GIS map with data on roads & bridges can retrieve and analyze visually to help decision-makers in planning, monitoring and maintaining of roads and related assets in a better way. A web enabled GIS system can not only take the decision support system to the next level by providing secure access to information over the world wide web but also to take timely and accurate decisions related to planning, monitoring and maintaining of roads and related assets anytime, anywhere.

### *e-Pathai* GIS

TNHD rightly envisioned an *e-Pathai* GIS: a Web based GIS to assist them to rationalize decision making in planning, programming, funding, procurement and in the allocation of resources in road sector in order to make the best use of public funds in preserving the road networks at an acceptable level of serviceability. The system will also improve the technical capacities, skills and management capabilities of TNHD and other related agencies associated with road management and maintenance thus improving the ability to manage efficiently and cost-effectively road maintenance and improvement activities. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends. The system is a mix of digital base maps for Tamil Nadu consisting of several layers (spatial data) compiled from different sources such as Survey of India (SOI), National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Wikimapia, High Resolution Satellite Imagery etc. and attribute data (non-spatial data) on roads, bridges etc. from RMMS database besides other attribute data of interest such as demographic details from Census of India, average annual rainfall data from India

Meteorological Department. The Web GIS based Road & Bridge Information System developed for TNHD under *e-Pathai* GIS is a web based system for

- readily accessible, relevant and valid information on the road network and related infrastructure.
- effective decision making in planning, programming, funding, procurement and in the allocation of resources in road sector.
- effective prioritization of works as well as reporting on its condition.
- improved support for decision-making through GIS analytical tools.
- evaluating the roads and related infrastructure for planning & programming purposes...

### Client Server Model

*e-Pathai* GIS is based on client-server architecture. Client-server architecture is a way of designing software that takes advantages of the ability to distribute data and processing chores across a network. The main part of the application runs on a centralized server and any user across the globe can use or access the server application using a client software i.e. browsers like Internet Explorer, Mozilla Firefox, etc. designed for this purpose.

### *e-Pathai* GIS Components

The Web GIS built using ESRI® ArcGIS® for Server (Advanced Edition), Microsoft® Silverlight and Microsoft .NET framework is supported by a set of powerful customised query and analysis tools.

### Spatial & Non-Spatial Data in *e-Pathai* GIS

Several spatial and non-spatial data have been integrated into *e-Pathai* GIS from several sources. The key sources for spatial and non-spatial data are Survey of India (SOI) Open Series Maps (OSM) and RMMS. The SOI layers in *e-Pathai* GIS are available only to departmental users (TNHD) due to sensitive nature of data. Spatial data for 20,000 Km (SH and MDR) based on GPS data stored currently in RMMS has been used to create a graphical representation of the roads in *e-Pathai* GIS. The spatial layer thus created has been linked with the related non-spatial or attribute data in RMMS after cleanup of the graphical data for various inconsistencies. In addition to the OSM digital data from Survey of India, several other spatial and related non-spatial data have been compiled as additional layers (MLA, MP constituency boundaries, soil boundaries, District wise Annual Average Rainfall (i.e. Normal) for Tamil Nadu etc.) from various sources after appropriate undertaking and permission in the *e-Pathai* GIS. It may be noted that in addition to the spatial and non-spatial layers included in the Web GIS as in **Error! Reference source not found.**, several other spatial and non-spatial data of relevance to TNHD have been identified along with the probable source for the data for inclusion in *e-Pathai* GIS in future.

### *e-Pathai* GIS: Overview of Key Features

*e-Pathai* GIS is a web-based application written in .Net / Silver light technology which is a cross-browser, cross-platform technology. It runs on all popular Web browsers including Microsoft Internet Explorer, Mozilla Firefox and Google Chrome. The Web GIS built using ESRI® ArcGIS® Server, Microsoft® Silverlight and Microsoft .NET framework is supported by a set of powerful

customised query and analysis tools developed specifically for TNHD. Some key features of the Web GIS application listed below have been developed based on the data currently available with the department:



**Locate:** Spatially locate various elements on the GIS map such as Boundary (District, Taluk, MLA, MP etc.), Road, Bridge, Culvert (Quick locate and by TNHD Circle, Division and Sub Division).



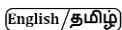
**Query Roads, Bridges and Culverts:** Query Roads by CW Surface Type, CW Width, Drain Condition, Pavement Composition, Category, CBR, IRI, Inventory Details, Shoulder Type, Shoulder Width, Soil type, Terrain Type, Work History, Traffic (ADT & AADT) etc. Culverts can be queried by Culvert Types and Condition and Bridges by Bridge Condition and Type.



**Thematic Maps:** A thematic map is a GIS map that focuses on a specific theme or subject. Users of TNHD Web GIS can create thematic maps for roads using the Query->Roads functionality. The Web GIS application will automatically paint or re-color the road stretches based on any of the road characteristics such as CW Surface Type, CW Width, Drain Condition, Pavement Composition, Road Analysis, Category, CBR, IRI, Road Inventory Details, Shoulder Type, Shoulder Width, Soil type, Terrain Type, Work History, Traffic (ADT & AADT) etc. Similarly thematic maps can be currently generated for Culverts by Culvert Type and Condition and for Bridges by Condition and Type attribute. Reports can also be generated for these maps.



**Bing Maps** is a web mapping service provided as a part of Microsoft's Bing suite of search engines and powered by the Bing Maps for Enterprise framework is also available in the application as a backdrop layer besides Open Series Maps of Survey of India. Bing aerial view overlays satellite imagery onto the map and highlights roads and major landmarks. Using Bing services it is possible to locate a point or address of interest, find shortest route between two places by distance or travel time.



**Bi-Lingual Interface:** Web sites and web applications in local language have become the order of the day. The Web GIS for TNHD currently has a bi-lingual interface allowing users to switch between English and Tamil language.



**Identify Selected Features:** Hidden attribute information pertaining to the selected features in only a mouse click away. If the feature belongs to more than one layer, user can select the desired layer from the 'Identify From' tool bar.



**Mouse over info:** Hidden attribute information can also be quickly accessed for a user defined layer such as taluk, district, road, culvert, bridge etc. by just moving the mouse over the feature after selecting a layer of interest.



**High Resolution Map Printing:** Generate high quality PDF files of your GIS analysis/ maps for most common paper sizes and download them for sharing.



**ROMDAS Video:** ROMDAS video has been integrated with the Web GIS. Camera icon is displayed at locations where ROMDAS video is available. Clicking on the camera icon at the required location plays back the ROMDAS video for the selected location.



**Vehicle Damage Factor (VDF)** tool provided can be used to switch on the census stations having VDF information. When the VDF tool is clicked census stations will display the VDF icon on the map. When the VDF

icon at a census station is clicked the relevant VDF information is shown to the user.



**View elevation profile along a road:** This is a handy tool to understand the elevation or profile of the terrain along a selected road stretch. It is also possible to generate longitudinal profile along user defined alignment, which will be useful for route planning.

And many more such interesting features and functionalities are explained in the subsequent chapters of this user manual.

**e-Pathai GIS: Snap shots of the Web GIS**

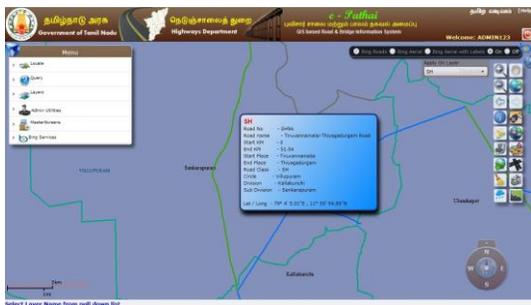
Snap shots of some key features of the Web GIS application have been illustrated below:



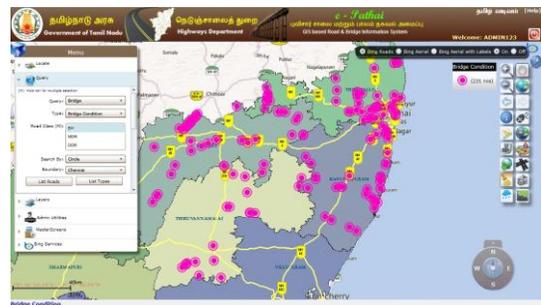
**Fig: 1 – e-Pathai GIS Home Screen**



**Fig: 2 Identify Selected Feature for SH**



**Fig: 3 Mouse over features (State Highways) for information**



**Fig: 4 Thematic for Query on Bridge Condition**



**Fig: 51 Thematic for Query on Road by IRI**

தமிழ்நாடு அரசு  
Highways Department, Government of Tamil Nadu  
International Roughness Index Report

Circle	Division	Sub-Division					
Chennai	Thiruvallur	Ponneri					
Road No: SH041	Class: PCR	Road name: Nungu-Latter-Thiruvalluram Road					
Sl.No	Start Km	End Km	Length(Km)	IRI	IRI Condition	Survey date	
1	4.90	5	0.10	5.88	[4-7]Fair	20-07-2008	
2	4.20	4.40	0.20	6.65	[4-7]Fair	20-07-2008	
3	3.40	3.50	0.10	6.72	[4-7]Fair	20-07-2008	
4	3.30	3.40	0.10	6.04	[4-7]Fair	20-07-2008	
Total Road Length(Km) : 0.40							
Total for Sub-Division(Km) : 0.40							
Total for Circle(Km) : 0.40							
Summary							
NBR						(4-7)Fair	0.40 (100%)
Total							
Total length of NBR(Km)						0.40 (100%)	
Total Length(Km)						0.40 (100%)	

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**Fig: 6 Report for Query on Road by IRI**



Fig: 7 Thematic for Query on Road Work History



Fig: 8 Thematic for Query on AADT



Fig: 9 Thematic for Query on Road Drainage Condition

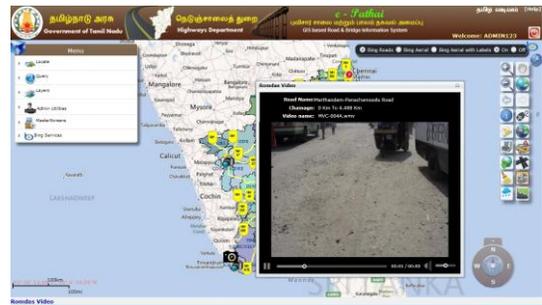


Fig: 10 ROMDAS Video integration

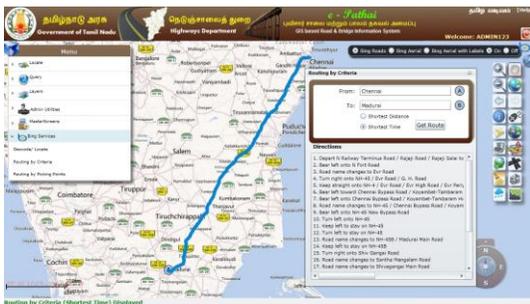


Fig: 11 Routing by Criteria by Shortest Time/ Distance

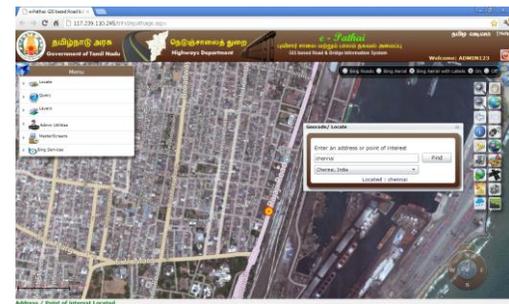


Fig: 12 Bing Geocode / Locate

**Conclusion:**

*e-Pathai* GIS has been programmed in such a way that the public can also access details about bridges, roads and other projects implemented by the highways department. No doubt that this new, robust and holistic initiative has been appreciated by the World Bank, is sure to assist them to rationalize decision making in planning, programming, funding, procurement and in the allocation of resources in road sector in order to make the best use of public funds in preserving the road networks at an acceptable level of serviceability.