

RESEARCH ARTICLE



ISSN: 2321-7758

## GEOSPATIAL DATABASE DEVELOPMENT FOR TRANSPORTATION PLANNING USING SOI MAPS AND SATELLITES DATA UNDER GIS ENVIRONMENT

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### ABSTRACT

In this era of economic redeem, proliferation and liberalization Indian cities are encountering increased rate of growth since the Independence and now developing as a centers of domestic as well as international endowments. Exploiting the modernized mechanization and technology planners and technologists forge opportunities to mentor the process of planned development and its management. In the ambience of the transport planning the whack and availability of the high resolution data has reform and remodel the process of thematic planning. . As the country's transportation system represents the country's development stage, developing countries like India are spending lots of money, efforts and exercise in the transportation planning and management and solving the issues, problems related to the transportations system. To constitute and envisage various planning outline and synopsis for decision making, GIS emanate as a robust tool for the integration and scrutinizing the numerous thematic layer and the attribute data and the information. For scrutinizing both the spatial and non-spatial data GIS has emerged as the robust tool and also for clarifying numerous different problem related to the networking. The practice of application of the GIS in the distinct range of the issue in transport planning is very common now a day. GIS has emerged as the competent tool for formulating the basic transportation related model and data in order to expedite the input, analysis and display of transportation related result. The present research work deals with geospatial database development for transportation planning of Allahabad City of Uttar Pradesh State in India through the use of the GIS data model prepared with the help of spatial data like SOI maps, Engineering maps and satellite images as well as non-spatial data under the GIS environment. SOI map of Uttar Pradesh 63K12 and of Allahabad City G44P15 and attribute data are used for the preparation of geospatial database for transportation planning of Allahabad City. The various thematic layers prepared and generated include City Road Network, Allahabad Wards, Public Transport Terminals and Allahabad Auto and Bus route. The GIS database provide the entire fundamental associated to routing and analysis of the transportation system, such as various modes of the transportation, routes existed for these modes, road network present in the city, structure of the road and the routes etc.

**Key words:** Transportation planning, GIS, Geospatial, Database, Thematic Layer, Georeferencing.

## INTRODUCTION

The urban expansion or development of the local economies depends on the several factors such as transportation network like (land, water and air), population increase and most importantly amount of the land available. (Markon, 2003). The efficiency of urban settlements largely depends upon how well they are planned, how economically they are developed and how efficiently they are managed (Tiwari,2003).The Urban transportation system is very complex in nature because of the different mode of transportation available in a high density area with the limited space due to increasing transport demand. All of the Indian cities are facing the crisis of urban transport. In large cities there is a rapid increase in the personal vehicles where as in smaller cities different modes of public transport have sprang up which are inadequate in catering the increase in transportation demand of the public. Various schemes and planning have been done to meet this issue but nothing is working so far. Master plans are being prepared for most of the metropolitan cities are having brief reports in the urban transportation. Despite of the increase in investment in the planning of the public transportation of the cities nothing positive solution is being evolved even after so many experiments. Therefore, with increasing urbanization and urban travel demands the different solutions have to be considered so that to meet the demand of the public. The same road space gets used by modern cars, buses, along with locally developed vehicles for public transport (three wheelers), scooters & motorcycles, bicycles, rickshaws, animal and human driven carts. This requires careful understanding and innovative solutions to meet the diverse demands. Policy framework for optimal modal mix in this context should promote innovations in road designs, institutional modifications, vehicles designs and innovative financial schemes. [Tiwari, 2007].

Geographic Information Systems (GIS) can be used as a valuable tool for the representation and analysis as well as discussion of transportation systems as variety of information needed in the field of Transportation. In addressing the needs of transportation systems GIS have proven to be an integral tool. Because of the well-established vector as well as raster data structure it is considered that

the GIS is the most fruitful means for the organizing basic transportation related data in order to facilitate the input, analysis, and display of results. A geographic information system or GIS is a configuration of computer hardware and software specifically designed for the acquisition, maintenance, and use of cartographic data." [Tomlin, 1990]

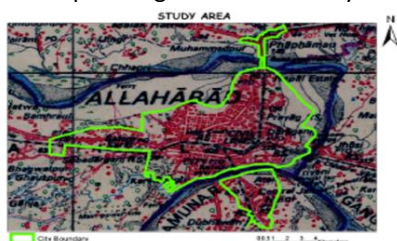
**Role of Geographic Information System:** GIS is one of the most powerful of all information technologies because it focuses on collecting knowledge from multiple sources as well as it creates a crosscutting environment for collaboration as many have characterized. GIS is, "An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information." [Foote, et al, 1990]. Approach in GIS-based tools and databases have made very simpler to construct and model the urban pattern of an area (Gupta et al., 2001). As it is rooted in the science of geography it combines a powerful visualization environment with a strong analytic and modeling framework. That is why, it has resulted in a technology that is science-based, trusted, and easily communicated across different cultures, within different social classes, languages, and disciplines. The information obtained from remote sensing data has to be reliable and therefore must carry some sort of quality label. Then only the usefulness of this quality label is obtained when combining different data sets in a GIS or when using it as input for different spatial models (Hagman, 1998).

Transportation data encompasses a wide range of spatial data entities that are fundamental to many Geographic Information System and cartographic applications. For the base maps transportation data is considered as a key element. It also served as essential reference data in the respective context. Transportation data is at the core of applications as in the emergency response, routing, urban and regional planning, public transport, municipal service provision and general purpose mapping besides its role as the reference data, transportation data is at a core of applications, such as emergency response, routing, urban and regional planning , public transport, municipal

service provisions and general purpose routing. From local traffic planning to managing infrastructure at a national level transport models are used for a wide range of purposes and they can also be providing the basis for evaluating the environmental impacts of transportation. A GIS can be considered as chain of operation for working with spatial data, their storage and analysis to the use of the obtained information for some decision-making process. GIS can play an crucial role in resource management, environment monitoring, land use and planning activities ( *Xinhong and Hua, 1992*).

**OBJECTIVE OF THE PRESENT WORK:** The present research work deals with geospatial database development for transportation planning of Allahabad City of Uttar Pradesh State in India through the use of the GIS data model prepared with the help of spatial data like SOI maps, Engineering maps and satellite images as well as non-spatial data under the GIS environment.

**STUDY AREA OF THE PRESENT WORK:** Allahabad City is selected as study area, which has a complex road network and also transportation system. It has various road network and transportation mode in the different part of the city. Main city has irregular roads where as Civil line has a systematic road network. Allahabad is located between 25°24'00"N to 25°32'00"N latitudes and 81°45'00"E to 81°55'00"E longitudes in the southern part of the Uttar Pradesh at an elevation of 98 meters (322 ft.) and stands at the confluence of the Ganga and Yamuna rivers. The Municipal area of the city is 97 km<sup>2</sup> has a population of 1117094 and is divided into 80 wards for administrative convenience and density of 1086 person per km<sup>2</sup>. The maximum temperature is 48 °C (118.4 °F), and its lowest is -2 °C (28 °F) while the annual rainfall is 1935.5mm. SOI map of Uttar Pradesh 63K12 and of Allahabad City G44P15 and attribute data are used for the preparation of geospatial database for transportation planning of Allahabad City.

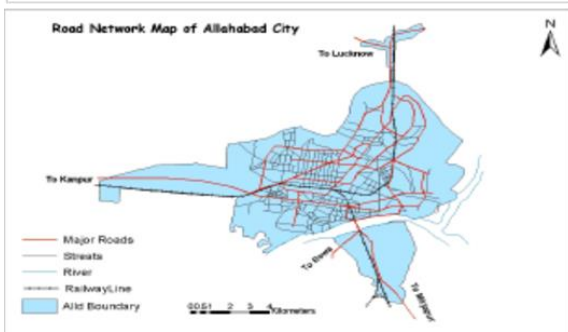
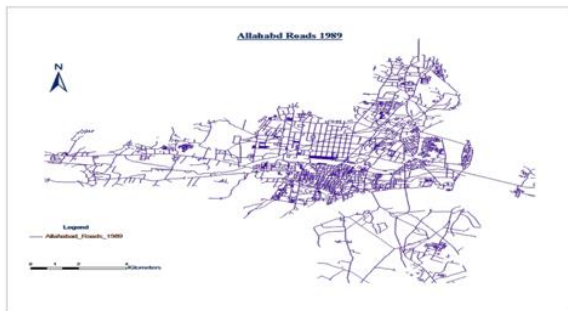


**METHODOLOGY ADOPTED IN THE WORK:** For the development of geospatial database for Allahabad city, ArcGIS 10 GIS software has been used. SOI map of Uttar Pradesh 63K12 and of Allahabad City G44P15, satellites images are used as the base map for the preparation of geospatial database. Collected maps have been scanned with the help of Vidar Select P42 scanner and saved in TIFF format setting the resolution to 300 DPI. The Allahabad guide map has been taken as the base map for georeferencing. Survey of India topo sheet 63 K/12 is used to georeferenced the Allahabad guide map. Then Allahabad guide map is taken as reference map for georeferencing the other maps and drawing in the Arc Info. Projection system is defined after georeferencing the maps in the Arc Toolbox in Arc Info. The shape files are created in Arc CatLog to store the line, polygon or point features and the layers containing data's are created in ArcMap. Different layers such as Roads, Stops, and Ward Boundaries are created with the help of Shape files. Route editing toolbar is used for the creation of the routes from the existing lines in the Arc GIS. Arc Catalog creates a geodatabase in the Project folder. In Arc CatLog featured database are created and feature class is imported in featured database. After layer creation fields have been added for entering the attributes in Arc CatLog or ArcMap. Spot Images obtained by Google Earth has been used for the updation of our digitization. Thus an updated digital map for analysis is prepared. Digitization is done to edit extra roads and boundaries to obtain the updated information. A final digital image of whole transportation system is obtained in the GIS environment. Spatial data and the Tabular data residing in the MS Excel are integrated in GIS environment using Arc Info Edit Toolbar. Transportation system of the city is analyzed with the help of prepared database through attribute table. The Arc Objects of ArcGIS provide base for application revision that lets one to make user-specific and user-friendly module skeleton to serve the specific needs of the end-user (*Burke, 2004*).

**GEOSPATIAL DATABASE DEVELOPMENT:** The details of thematic maps created along with their attributes data for the development of geospatial database of Transportation System of Allahabad city are discussed under subsequent heads.

**CREATION OF SPATIAL DATABASE:** SOI Maps, Engineering Drawing and Satellite images are taken up as base maps for the project. These maps are scanned and converted into different format like TIFF, JPEG as required. Spatial data are available in the geographical form which contains the location and shape of geographic features. Maps use three basic shapes to present real-world features: points, lines, and areas (called polygons). Spatial layers that required to be incorporated into the system are identified and the work of spatial data creation for the transportation system is taken up in collaboration with Allahabad Guide Map (1:50,000 scale) as base maps, ward map and Google maps.

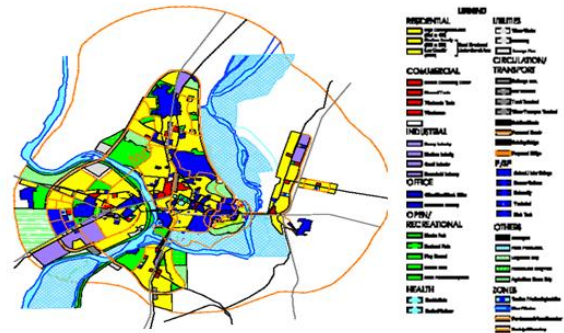
**City Road Network:** Allahabad roads have been considered as line Feature data type. Two types of road layers have been created. One is using Allahabad Guide map 1989 (Figure) and second is using Allahabad Google map (Figure).



**Allahabad wards:** There are 80 wards in Allahabad city. The ward map of Allahabad city is shown in Figure. It is a polygon layer.



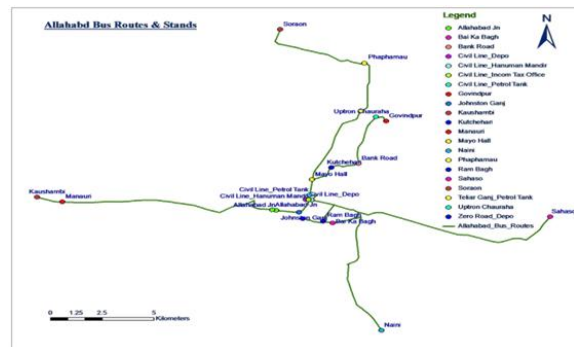
**Allahabad Land-used:** Land use map of Allahabad obtained from Allahabad Development Authority is shown in Figure .It also has been created as Polygon Feature type. It was extracted by using Allahabad Master Plan.



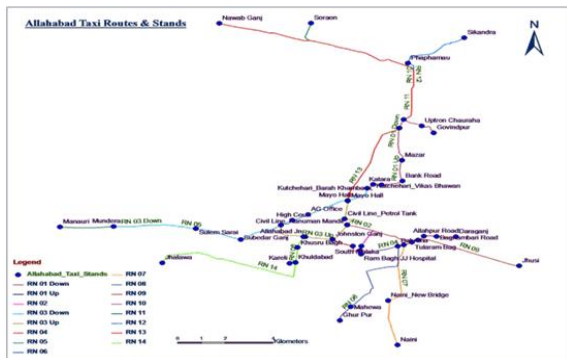
**Public Transport Terminals:** The public transport terminals such as bus stands, taxi stands were created as point feature. This map is shown in Figure



**Allahabad Routes:** There are two types of routes in Allahabad City. One is auto/Vikram routes and second one is bus routes. These routes have been created by using Route editing Toolbar. It is shown in Figure and Figure







**CREATION OF NON SPATIAL DATABASE:** Various collections of the documents and data's have been obtained from PWD road directory and other transport organization. Taxi stands and bus station are surveyed for the collection of data and routes. Updated road statistics data are used for the preparation of the data collection sheets. Software like MS Office Word and Excel 2010 has been used for inserting the collected data in the Database. Non-spatial data are generally in attribute that is in tabular form. These are illustrative data that GIS links to map features. Attribute data are cluster and congregate for distinct areas like of states, census tracts, cities, and so on and are generally compiled with map data. Attributes data that is required to couple with the spatial data layers are determine. Attributes thought of considerable significance while planning and monitoring of the transportation system are collected and compiled together with the spatial database.

**INTEGRATION OF NON SPATIAL DATA AND SPATIAL DATA:** Common identifiers are used for development of the integrated geospatial database that is for the properly linkage of spatial database with the non-spatial database. Arc Info is used to integrate spatial data and the Tabular data residing in the MS Excel in GIS environment. In Arc Info spatial data are properly linked with the attribute data. The attribute tables are linked with the Allahabad city map so as to form the thematic layer to form the geospatial database. The unified geospatial database has thus been created of the Allahabad city in the GIS environment.

#### CONCLUSION

GIS based geospatial database has been developed to assess, map and to monitor the urban transportation of Allahabad City. The geospatial database is compactible and can be revised to

receive additional information about the city in the form of new thematic layers in future so as to make it more complete. The Thematic layer developed by merging the various different parts of geospatial database and executing it under GIS environment will help the planners of Allahabad city in making more informed decisions in the field of transport planning and its management. The user interactive thematic maps developed are expected to increase the acceptability and utilization of integrated geospatial database among planners and decision makers. The GIS based geospatial database framework adopted and developed in the present work may be approved for other urban cites for their transportation planning by making alteration in the input parameters and data.

**DISCLAIMAR:** Trade and Product names are mentioned for completeness and no endorsement is intended by the authors or the institute concerned.

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