ROAD NETWORK ANALYSIS OF DEHRADUN CITY USING HIGH RESOLUTION SATELLITE DATA AND GIS

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Mobility is the backbone of the activity system of the human race. Adequate mobility tends to broaden the perspective of an individual in particular and society in general. Road transportation network has been an essential infrastructure facility, which need to be developed and maintained to accommodate a growing population and economy, the importance of which was never more prominent than in the Indian subcontinent during British regime and after the independence. During this period, proliferation of road, rail, and airline networks in the country has helped to increase the range of cities and reduce the isolation of rural areas. The emergence of these networks meant unprecedented freedom of movement for the population and is closely tied to the continued growth of the economy. Providing real time information to the road users and guiding them to choose appropriate mode of transport and optimal routes is very vital in enhancing the efficiency of transport system. However, problems associated with its use are also widespread, such as urban sprawl and air pollution. The lack of adequate and continuous streets in many Indian cities including the Dehradun City, coupled with the lack of effective land-use controls, overloads many major arterial roads. Public transport service remains always inadequate to provide congestion relief. At the outset of the 21st century, many components of our transportation system have already exceeded their design lives and are suffering from wear and tear due to higher than expected use. The major challenges are now to rebuild the transportation system in place and to use it more efficiently and responsibly with clear functions of planning, design, construction, operation, and maintenance of multimodal systems for the transportation of people and goods. Areas such as network analysis, operations, logistics, financing and policy analyses are important fields of study in transportation engineering in addition to core facility (roads, railroads, bridges, airports, harbors etc.) planning and design (Sinha et al., 2002).
In the late 90s, in the North American continent, traffic-simulation software became versatile for conducting technical studies in decision making. Geographic Information Systems (GIS) is an offspring of this computing revolution (Abkowitz et al., 1990; Quiroga and Bullock, 1996; and Souleyrette et al., 1998). The ability to integrate different databases into one system and their overlay information in different colours and layers has helped us to better understand as to how the various aspects of the system interact, and it assisted us in making better decisions based on a sound approach. For the last one-decade lots of efforts are being made in carrying out network analysis using GIS in routing and allocation applications. Routing involves finding the optimal path between any two nodes in a network. Route analysis aims at minimizing the cost of travel involved in transporting goods/people from one location to another whether in terms of trips required or distance or a combination of these. Application of network analysis for management of transportation system using GIS for Indian conditions is a difficult task as the GIS-software modules have been developed by developed countries with their transportation network in view. Despite the above-mentioned fact, an attempt has been made to apply network analysis in the context of Indian scenario. The main source of literature for this study were manuals of ArcView Analyst (Environmental Systems Research Institute, 1996), recent books related to GIS and transportation with chapters on network analysis (Cova, 1999; Ian Heywood et al., 2000; Korte, 1990; Milliar and Shaw, 2001; Waters, 1999; and Yue-Hong Chou, 1997), unpublished reports from IIRS, and web sites.

In the present study, high-resolution IKONOS data was used to derive thematic maps of road network and places of interest of the Dehradun City. Use of IKONOS image of Ward No. 29 of Dehradun City is shown in Fig.1. IKONOS earth imaging satellite has been providing reliable stream of image data that has become the standard for commercial high-resolution satellite data products. It acquires images in 1-meter black-and-white (panchromatic) and 4-meter multispectral (red, blue, green, near infrared) that can be combined in a variety of ways to accommodate a wide range of applications requiring high-resolution imagery. IKONOS is the first civilian remote sensing satellite system to use Time Delay and Integration (TDI) for generating high resolution data. Use of IKONOS imagery is similar to use of aerial photos and both used as a base map and a data source. One-metre resolution of the imagery up to a scene size of 11.3 × 11.3 km would be beneficial for managing vegetation in parks or for graphically linking names, addresses, parcels, roads and other network data to the level of an individual parcel.

The objectives of the present study are: (1) To find out which route one has to take if one intends to go from any place to any other place by any mode of transportation of his choice, through entire road network in and around Dehradun City, by the criteria provided by the user, which is known as Network Tracing. (2) To find out which route one has to take if one intends to go from one place of interest to another, i.e., an optimal path from a pre-defined source to another pre-defined destination, which is known as Source-Destination Path under Path Analysis of the Network Module. This is a case of a person intending to visit specific destinations of interest from any starting point along the six bus routes and bus stops within the road network of the City. (3) To find out which bus route one has to take if one intends to visit all the places of interest with best possible order, which is known as Tour Analysis of the Network Module. In this paper, road network analysis of the City was undertaken using IKONOS data and the said network analysis modules to solve some of the problems related to bus routes and their connectivity to various places of interest.

Dehradun City lies between 30° 15' - 30° 25' N latitude and 77° 58' - 78° 07' E longitude. The aerial extent of the City is 300 km². Dehradun is one of the most alluring picturesque valleys in Asia, one of the most important towns of the state of