T- Network Analysis of Hisar Town by Using High Resolution Satellite Data

Ankur Sharma[1]
[1]Haryana Space Applications Centre (HARSAC), CCS HAU Campus, Hisar-125004, Haryana, India
Email: ankur4uu@gmail.com

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ABSTRACT

ESRI Social Network Analysis (SNA) provide multiple solution aspects for a variety of problems pertaining to T-networks include understanding the location science for efficient travel route, generating travel directions, locating the closest facility and defining service areas based on travel time and distance covered. The present study analyzed the potential use of network and in defining the optimal service area of different services such as hospitals, schools and fire stations of Hisar city. Quick Bird (0.6 mtr.) image of Hisar city has been used for this study; it was then geo-referenced. Digitization was carried by using Shape file generated for different analysis. The network analysis tool was used to measure the efficiency of services in terms of time and distance. It also help in analyzing the gap existing in the spatial allocation of these services in city area and whether the existing resource allocation is good or bad in term of efficiency of these services. Network analysis in GIS rests firmly on the theoretical foundation of the mathematical sub-disciplines of graph theory and topology.

INTRODUCTION

Worldwide, the transportation problems faced by various nations have increased manifold, necessitating search for methods or alternatives that ensure efficient, feasible and faster means of transport. This is all the more true in a country like India, where in the population growth in metros is increasing significantly. Various situations, particularly emergency situations demand a method that can ensure speedy transportation e.g. Ambulance Services, Fire Services etc.

Network analysis is used for identifying the most efficient routes or paths for allocation of services. This involves finding the shortest or least-cost manner in which to visit a location or a set of locations in a network. The "cost" in a network analysis is frequently distance or travel time. A network is a set of linear features that are interconnected in GIS. Common examples of network include highways, railways, city streets, transportation routes (e.g. transit, school buses, garbage collection etc) and utility distribution system. Therefore network provides the movement of people and goods, the delivery of services the flow of services as well as communication of information.

Geographic Information Systems (GIS) have long been recognized as a valuable tool for the representation and analysis of transportation networks and related activities. GIS have proven to be an integral tool in addressing the needs of transportation managers. Through the well-established vector data structure, GIS has provided an efficient means for organizing basic transportation related data in order to facilitate the input, analysis, and display of transport network. A network is a set of linear features that are interconnected in GIS. Common examples of network include highways, railways, city streets, transportation routes (e.g. transit, school buses, garbage collection etc) and utility distribution system. Therefore network provides the movement of people and goods, the delivery of services the flow of services as well as communication of information.

Three Principal Types of Network Analysis are:

1. Network Tracing: Network tracing determines a particular path through the network. This Path is based on criteria provided by the user.

2. Network Routing: Network routing determines the optimal path along a linear network. The selection of the path can be based on numerous criteria**.**

3. Network Allocation: As well as one of the most important processes in the Planning and investment activities is network allocation. In other words, Network allocation is an analysis occurring at the same time of geographical entities and determination process as a point of the optimum center.

STUDY AREA

Hisar city, previously spelled as Hisar, is the administrative headquarters of hisar district in the state of Haryana, in northwestern India. Hisar is located at 29°05'05" N latitude and 75°45'55"E longitude on the Sirhind branch of the Western Yamuna Canal. It is situated 170 kilometer northwest of Delhi on the National Highway NH10.

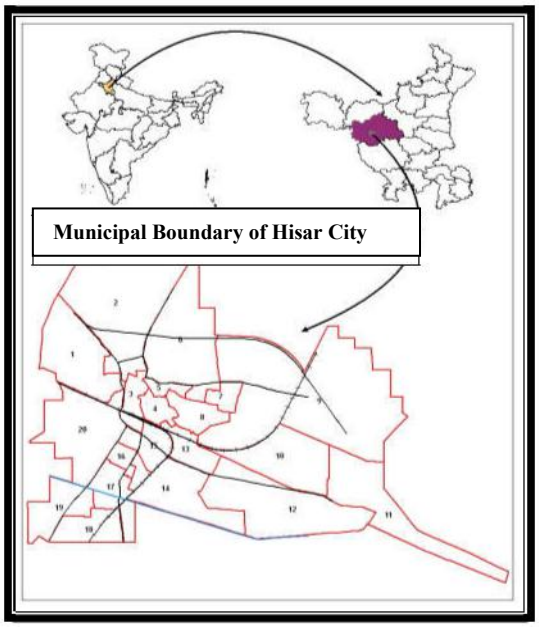

Figure 1: Study Area Map

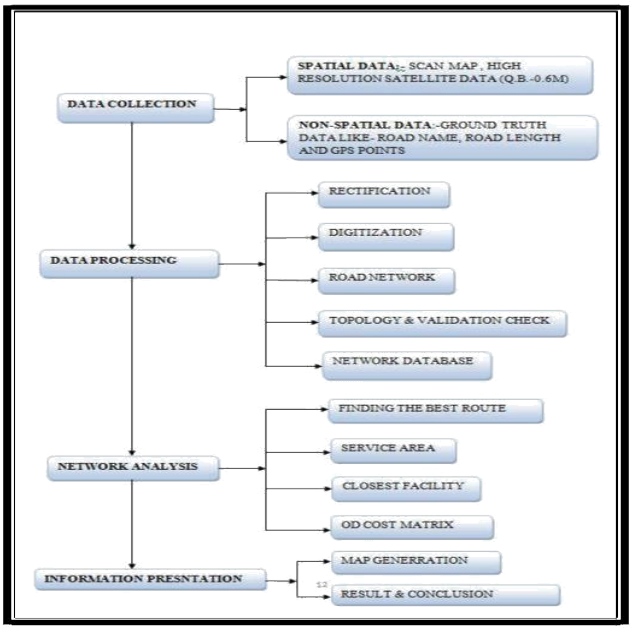

Figure 2: Methodology Flow Diagram

OBJECTIVES OF THE STUDY:

The objectives of the present project are:

1. Prepare a Road Network map.
2. Prepare a Facility map.
3. Finding the best route map.
4. Finding the service area.
5. Finding the closest facility.
6. Creating an OD cost matrix.

MATERIALS & METHODOLOGY

For the network analysis of the Hisar city a methodology was framed which includes following steps:

1. Data Used

A Quick Bird (0.6 mtr.) satellite imagery, which was geo-referenced in ArcGis 10.0, was used for the network analysis of the Hisar city. Location of public utility such as college, school, hospitals and fire station etc. were obtained from android based smart phone having Geo-tagged facility and their shape file were generated in ArcGis.

2. File Geo-database Creation

For generating Geo-database following data has been used:

1. City road network Shape file.
2. Shape file of public services such as college, school, fire station etc.

3. Data processing and Analysis

1. Geo-referencing of Hisar city image.
2. Generation of Shape file of school, Fire station.
3. Digitization of road network.
4. Generate topology.
5. Generate Network Dataset.
6. Analysis by using network analysis tool.

RESULT & DISCUSSION

1. Identify the shortest route between two locations which has less time and less cost consuming

By using network analysis "shortest route" was created between two locations, which are more efficient in term of time and distance. Route just connect two nodes (origin & destination) and is diverted from the original path if there is exist stop in term of point, line or polygon.

2. Define service area based on distance and time for different facilities

The map below indicates the service area of different closest facilities based on the distance and time. By this analysis it may be analyzed the actual service area of different facility or hospitals, schools, fire stations were chosen for analysis purpose and defined their service area based on time and distance. Whether these facilities are enough for that area, if not then how much is required. Map shows the spatial distribution of different services such as atm, hospital, school through a network and called service allocation analysis. Main objective is to measure the efficiency of services in term of time and distance.

3. Define the closed facility from any service location to facility

Closed facility identifies how close any facility from the public utility location is. Usefulness of this identify if there is any incident (Bank) happen at particular location then user can trace how much time is required to reach the rescue team to the incident location from their location (Police Station).

4. Define the OD cost matrix

OD cost matrix identify, with in a fixed period of time with a fixed origin (Service Provider) and fixed destination (Service Centre) at various location is served by the provider so that the public services centre will be able to serve the public 24*7 without any delay. Map demonstrates that concentration of local market from the local bus stand around 500 meters and within 10 min. time.

ANALYSIS

1. Shortest Route analysis

Analysis show that if we want to travel from Multani Chowk to Bus Stand, short route is 1.8 km. within 3 min with a continues speed of 35 km/h. In any situation if a point barrier and line barrier is applied at Gandhi chowk and near katla ramlila road then analysis finds the new short route is 1.9 km within 3 min with the same speed via nagori gate. **Figure 3**

2. Service Area analysis

Analysis identifies the number of hospitals within a radius of 500 mtr. around multani chowk. Network identifies 2 famous hospital named Shani hospital and bimal jain hospital. **Figure 4**

3. **Closest Facility Area analysis**

The analysis identifies that if burglary is happened in the bank near you then by using this analysis you can identifies the nearest police station near these banks. Here we can easily analysis nearest police station is City police station from pnb, bank of india, hdfc and axis bank. City police station response to any of these 4 banks as compare to other police station. **Figure 5**

4. **OD cost matrix analysis**

OD cost matrix analysis demonstrates that if any service provider wants to distribute some item to the market within 500 mtr. distance and travel time to reach these market is 10 min. from the bus stand. Then analysis shows that 5 markets identify which satisfy these 2 conditions. **Figure 6**

CONCLUSION

Network analysis tools are most reliable to measure the efficiency of services in term of time and distance. It also helps in analyzing the gap exist in the allocation of these services in city area and help us in analyzing whether the existing resource allocation is good or bad in terms of efficiency of these service areas. So this study tries to analyze the potential use of GIS tool for network analysis. In fact by using network analysis tools number of things can analyze which are more relevant for different type of network analysis especially for transport planning we can create this type of analysis for different purpose like shortest path analysis, closed facility analysis, OD cost matrix. To identify emergency route or alternate route for public it is very crucial especially for transport planning.

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Figure 3

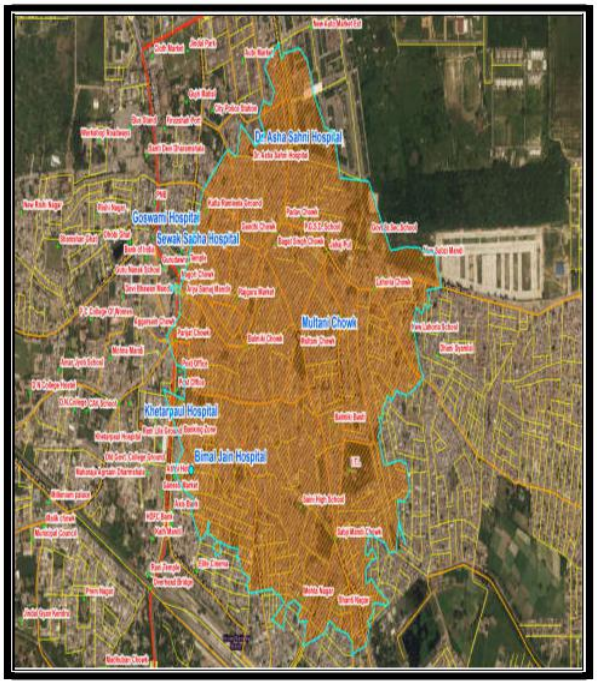

Figure 4

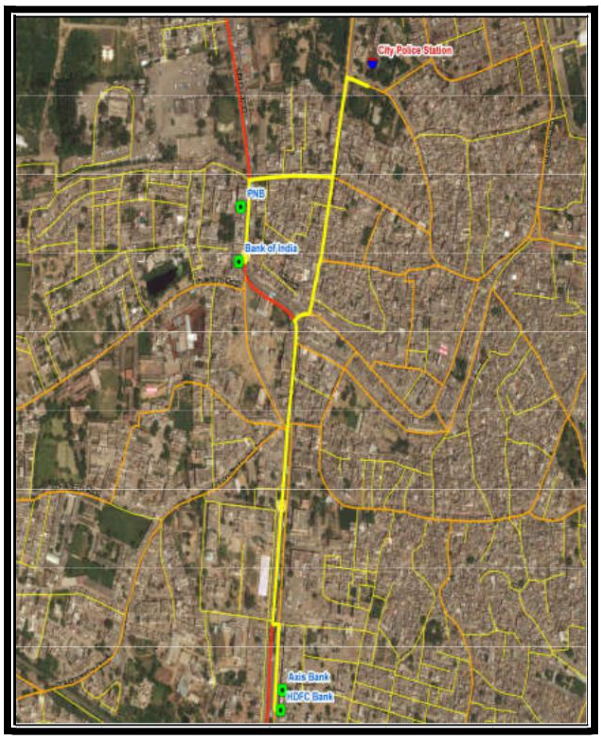

Figure 5

Figure 6

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