



GIS BASED OPTIMAL ROUTE ANALYSIS FOR THE TRANSPORTATION OF SOLID WASTE- A CASE STUDY FROM HYDERABAD CITY

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ABSTRACT

The objectives of this project are to create a spatial digital database consisting of LU/LC and road network maps with the help of IRS-ID, PAN & LISS-III merged data and SOI toposheets, to create database consisting of traffic volume, vehicle density and details of solid waste and to evolve an optimal transportation route maps for efficient, safe and economic disposal of solid waste. The final optimal route is obtained using arc view network analyst extension available in arc view GIS. The project results in giving optimal routes from the three transfer stations of Hyderabad to the dumping sites. A decrease in traffic density with less number of stops and turnings in these optimal routes resulted in more speed, less travel time and less cost and making the routes efficient, effective and economic.

Keywords: *Optimal Route Analysis, Solid Waste and GIS etc*

I. INTRODUCTION

Urbanization has brought forth several maladies and sufferings to human kind, besides bringing economic and cultural development in its field. Due to pressure of urbanization most of the cities, like Hyderabad are growing fast and sometimes they develop beyond the planned limits. Due to increasing industrialization and population large quantities of waste are being generated. Not all waste gets collected and transported efficiently to final dumping sites leading to improper management and disposal, resulting in serious impacts on public health and problems to surrounding environment. Solid waste addresses situations, which involve a variety of factors such as economic costs, legislative requirements, land use, pollution generation, resource usage and equity in the number of people affected. The efficacy of solid waste disposal depends upon selection of proper site, efficient waste transportation from the site of generation to the final site and proper disposal and management of waste at the dumpsite. Waste collection and transportation are therefore critical areas of urban planning. Remote sensing and GIS play vital role in transportation and urban planning applications. For a given origin and destination, one is always tempted to use the shortest distance route. But this need not always be the best route, in emergency situations, wherein shortest travel time is to be preferred over shortest distance. A shorter route does not always translate to shorter travel time, because it may be narrow in width or it may have higher volume of traffic, or more number of signals and turns and so on. The preferred option would be to revamp the existing collection service structure to provide community with waste bins, conveniently placed for the people to deposit domestic

waste, and a door-to-door collection of waste. This along with optimization of route from the source to the sink would not only reduce the cost of transportation but also reduces the ill effects caused to the surrounding environment.

II. STUDY AREA

Hyderabad city and its surroundings are considered for the study. It is located at 78°22'30''-78°32'30''E longitude and 17°18'30''-17°28'30''N latitude. A buffer of 50 kms from each of the four directions of the city is considered. The study area as a whole lies within 78°-79°E longitude and 17°-18°N latitude covering the parts of the districts namely Nalgonda, Hyderabad, Mahabubnagar, RangaReddy and Medak. Due to its vast urbanization the city as a whole is considered to generate 2200MTs of solid waste of which 65% is contributed by the residential sector. A detailed study of solid waste collection for the city is made. The twin cities have a 3000km of road network maintained by Municipal Corporation of Hyderabad apart from 85km of roads maintained by roads and buildings department of government of Telangana. National Highway 7 & 9 passes through the city.

III. STUDY OBJECTIVES

1. To create spatial digital database consisting of LU/LC and road network maps with the help of IRS-ID, PAN & LISS-III merged data and SOI toposheets and ground data on the ARC/INFO GIS platform.
2. Generation of Hyderabad municipal corporation boundary map at cadastral level and integration of attribute information.
3. Generation of detailed road network map covering highways metalled and unmetalled roads.
4. Creation of database consisting of traffic volume, vehicle density and details of waste like amount, transporting mode, etc.
5. To examine the existing solid waste disposal points.
6. To evolve an optimal transportation route map for the efficient, safe and economic disposal of solid waste.

IV. RESEARCH APPROACH

The project is executed through the following steps:

1. Acquisition of satellite data from NRSC, Balanagar, Hyderabad.
2. Acquisition of toposheets from Survey of India (SOI).
3. Preparation of base map providing the topographical details of the study area.
4. Preprocessing of satellite digital data and Georeferencing of data for image registration.
5. Preparation of hard copy/soft copy for the necessary interpretation.
6. Ground truth analysis by conducting limited field survey.
7. Mapping of road network for the year 1977 using Survey of India toposheets, APSRTC map and other related data.
8. Mapping of road network using PAN image of IRS-ID satellite data.
9. Scanning of these maps for necessary automated digitization using color scanner available at center for environment JNTU, Hyderabad.

relations, such as size, shape, distance and direction. Many spatial relations between objects are topological in nature, including adjacency, containment and overlap. The geometric relationship between spatial entities and corresponding attributes are very crucial for spatial analysis and integration in GIS.

In topology creation both the spatial and attribute data are linked from which different parameter maps are generated. These maps depict the spatial distribution of non-spatial information on spatial locations.

The present study provides optimal route from source (transfer station) to the sink (dumping site). It explains about the optimal route analysis for the transportation of solid waste for Hyderabad and its surrounding areas. Under this the various aspects covered include solid waste, problems that arise due to its rapid generation and urbanization, background, collection system followed, need for the optimal route, methodology, preparation of thematic maps like base map, drainage map, land use/land cover map and road network map, performing network analysis, development of optimal routes from transfer stations to the dumping sites using Arc View network analyst and preparation of outputs obtained, in a desktop functioning programming language (VB). The core issue of this study is to find the optimal route using Arc View GIS software.

In early times the transportation and disposal of human and other wastes produced in the city did not pose significant problem, as the amount of waste generated and the distance between the point of generation and disposal was less. But as the population increased, more land was occupied for residential and commercial purposes. As a result the dumpsites had to be relocated to far off places in order to reduce its impact on the public health, which in turn requires provision of better transportation facilities for the transfer of wastes to the dumpsites. Therefore optimization of route or selection of shortest route to the dumpsite considering the transportation costs including the fuel efficiency is very much essential.

Remote sensing and GIS can be effectively used to address the objective of finding the optimal route between the given origin and destination. It can be used to find the routes involving the shortest distances as well as shortest travel time thereby reducing impact of waste on public health and extent of air pollution caused during the transportation of the waste.

The present study thus develops a decision support system for optimal route analysis for the transportation of solid waste. This optimal route is obtained with minimization of distance, minimization of time and cost and presents a working and easy to use solid waste routing. For this Arc view GIS's network analyst is used. The network analyst of Arc View GIS may further be used in different studies like capacitated networks in which, Cost is minimized for a given flow between source and sink, flow is maximized between the source and sink at a given cost this is mainly to maximize the profit. The decision support system designed using Visual Basic for the present study is user-friendly and only simple applications of it are used. Further, it promises more professional and web applications like querying, report generating, adding and updating of database with skilled programming.

Availing the latest sensor capabilities of Remote sensing technology and the advantages of GIS tool the best possible optimal route is designed and developed for the effective transportation of solid waste. The decision support system developed in this work can be applied for other metropolitan cities as well.

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Figure1: Showing The Topomap, Satellite Imagery, Solid Waste Locations, Existing Dumping Sites & Transportation Vehicles

