

Analysis of Present Transport System of Aurangabad City Using Geographic Information System

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Abstract— The quality of life of the citizens is highly relies on the efficiency and effectiveness of its transportation system. The main goal of transportation is to get easy access to each and every location in the city. Effective transportation system helps to reduce time consumption as well as pollution at some extent. This paper presents an analysis of the Aurangabad city transportation system, role of Geographic Information System in transportation, pitfalls in the existing system and discuss different techniques for network analysis. It will show us clear picture where we need to focus to make Aurangabad as a smart city.

Keywords— Geographical Information System (GIS), Transportation, Smart City.

I. INTRODUCTION

Improvement of Public Transport, to diminish the increase in individual motorized traffic, is one of the major perspective when it comes to the reduction of negative impacts of traffic and the minimization in the energy efficiency of a transport system. The Smart and favorable public transport should not only good in service quality but also minimum in cost, to retain existing passengers or even attract new customers, these perspectives are highly dependent on framework conditions like urban densities, urban developments, regulatory conditions etc.

Today, the abrupt increase in the population exerts burden on public transportation. The most dense cities such as Hyderabad, Pune and Mumbai have bus as the main public transportation system, which plays a vital role in public transportation. Increase in traffic congestion, pollution, problems related to road safety and environmental issues are the preeminent concern for the new developing cities to consider new framework for the public transport system. Development and progress of the country are represented by the transportation system. Today, many countries facing transportation related problems and spending lots of effort and money to solve it [1][2].

Hence it becomes a difficult work to define an optimal public transport network, especially under conditions of rapid growth, increase in population and new infrastructure development as it is in Aurangabad City. Currently the transport system in Aurangabad city is driven by private

Auto transport and Municipality Buses. However, the future public transport system will still be mostly controlled by bus services to ensure the passengers [2].

II. STUDY AREA

Aurangabad is an ancient & a big city in the state of Maharashtra in India. It is considered as Historical and Industrial hub of Maharashtra that stands on the bank of Kham River. The study area is located in the Middle North part of the state and bounded by 19°53'0"N Latitude and 75°20'00"E Longitude and the total geographical area of the is 135.752 Km. The city has historical 52 Gates, but only 13 have survived over a period of time [3]. The geographical location map of the study area is shown in Figure 1.

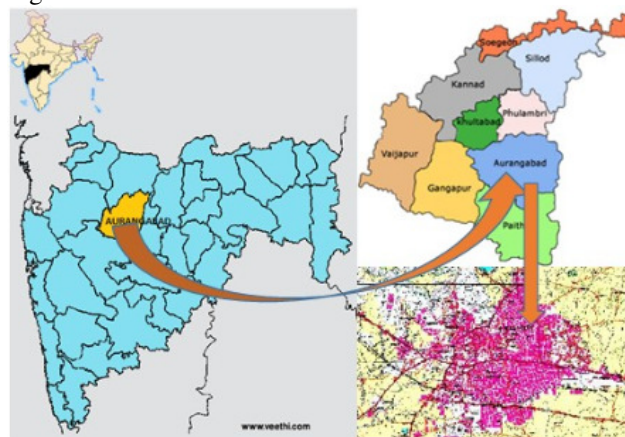


Figure 1: Aurangabad City Geographical location [4][5]

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III. ROLE OF GIS IN TRANSPORTATION

The application of GIS can be applied to various fields such as Solid Waste Management, Sewage, Power supply, Water supply, Transportation. It is a powerful tool for the analysis of both spatial and non-spatial data and for solving important problems of transportation networking. It provides a broad spectrum of development, offers easy and durable decision making.

There are a lot of advantages for using GIS in Transport system such as it possess the ability to produce quicker, repeatable data that can be used with the visualization tools commonly found in GIS to develop customized maps and tables and effective road network [6].

A. The planning and construction of new roads

GIS is highly used in the construction of new roads. By using GIS it becomes possible to analyze the outcomes of the new roads on area's accessibility, optimization of paths and minimizing the environmental and visual impact that the new roads might cause [7].

B. Route Planning

One of the most widely used application of GIS is route planning. With the help of GIS it becomes easier to find out the shortest route by road, bicycle, rail, air and public or private transport. It also considers different parameters such as journey time, financial cost and length of route with various combinations. Optimum routes can be found in cities, regions, countries, continents or on a global level. Even in cities with complex urban structures and countries with badly defined road networks [8].

C. Meteorological Hazard Control

Weather conditions play a very important role in transportation planning and control. By using GIS this information can be combined in route planning efficiently.

D. Traffic Control

In the field of traffic control GIS can be utilized very effectively by defining the route network for city transportation, mapping of various resources such as junctions, bus stop, auto stop, petrol pumps etc. [9].

E. Passenger Assistance Systems

It allows passenger to find out information about all the possible forms of collective transport inside the city area with timetables, fares, routes and even maps of journeys that can be downloaded via PDF files [10].

F. Emergency Management

GIS have been extensively used to offer the duties of the emergency services such as the ambulance service, police, fire brigade etc. However, the advances in mobile

technologies and GPS geo positioning techniques and their connection to GIS have led to an extraordinary facility [11].

IV. ANALYSIS OF TRANSPORT SYSTEM

Aurangabad city is divided into three Government organization. These are Municipal Corporation, City and Industrial Development Corporation (CIDCO) and the Maharashtra Industrial Development Corporation (MIDC). The transportation network has wide coverage, which covers 142.789 km² [4].

The aim of this study is to do an analysis of the current transport system in Aurangabad city and provide better solution to serve futures increasing population.

Possible modes of transportation in Aurangabad city.

1. Air
2. Rail
3. Road

The transportation through roads again divides into:

- a. Public transportation
- b. Private transportation

A. Public transportation

Aurangabad City is mainly dependent on Bus and Auto for public transportation. Aurangabad Municipal Corporation is the Prime planning Organization for the city, consisting of six zones with a population of approximately 11,71,260 as per census 2011 [4][12]. The present public and private transport system has various drawbacks which directly affect the traffic, ease of traffic and transport system. Population growth of the city from 1901-2011 has been tabulated here.

Census	Pop.	%±
1901	36,837	—
1911	34,902	-5.3%
1921	36,876	5.7%
1931	36,870	0.0%
1941	50,924	38.1%
1951	66,636	30.9%
1961	97,701	46.6%
1971	165,253	69.1%
1981	301,000	82.1%
1991	592,000	96.7%
2001	902,179	52.4%
2011	1,171,260	29.8%

Table 1: Population of Aurangabad City [12]

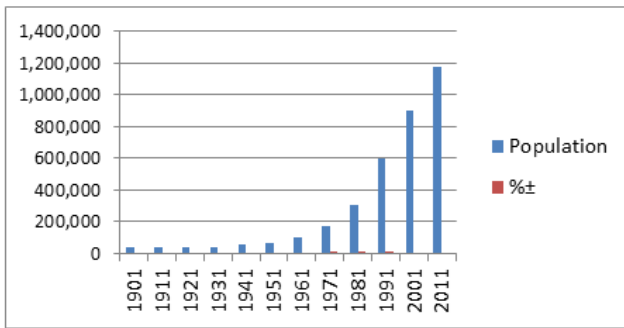


Figure 2: Shows population growth in Aurangabad city [12]

In recent years, there is tremendous increase in the population of Aurangabad city, which indirectly affects the transportation system. According to Regional Transport Office, Aurangabad, there are 5000 two wheeler, 165 four wheeler is passed out per month, whereas 60 to 65 three wheeler auto for transportation purpose are registered in the city [11].

Vehicle type	Vehicles registered/month	Total number Vehicles
Two wheeler	5000	--
Four wheeler	120-160	--
Three wheeler (Transport permit)	60-65	16807

Table 2: Vehicle registration in Aurangabad City

The Transportation system of the Aurangabad city requires much more improvement, as the passenger either have to wait for a long time at the bus stop or walk along and face huge traffic. There are 35 routes defined in Aurangabad city for the fulfillment of public transportation in the city which gives rise daily income of about 1 Lac 12 thousand to the Municipality.

The routes are as follows:

Sr. No	Route Name
1.	Cidco-Kranti Chowk-Railway Station
2.	Cidco-Pundlik Nagar-Gajanan Mandir-Roplekar-Pir Bazar-Railway Station
3.	Cidco-RoshanGate-Shahaganj
4.	Cidco-Gajanan Mandir-Shivajinagar
5.	Cidco M2-N-11-Jubli Park-Central us Stand
6.	Cidco-Kranti Chowk-Aurangpura
7.	Cidco-Mukundwadi-Dhoot Hospital-Chikalthana
8.	Cidco-Kranti Chowk-Baba Pump- Central us Stand
9.	Cidco-Baba Pump-Pandharpur-Bajaj Nagar
10.	Cidco-Baba Pump-Pandharpur-Ranjangaon
11.	Cidco-Hindustan Awas
12.	Cidco to Harsul
13.	Cidco to University via Baba Pump
14.	Cidco to University Via Harsul

15.	Cidco-Mondha Naka-Aurangpura
16.	Cidco-Kranti Chowk-Baba Pump-Padegaon

Table 3: Routes for Public transportation

Transit service coverage or in other words, the service area of each bus route which serve the citizens of a particular part of the city plays a key role in entire quality and also tendency to use of the urban transport systems. One may not have to walk for longer distance to catch bus, reach bus stop or any other public transport facilities, especially in rainy or too hot days [13].

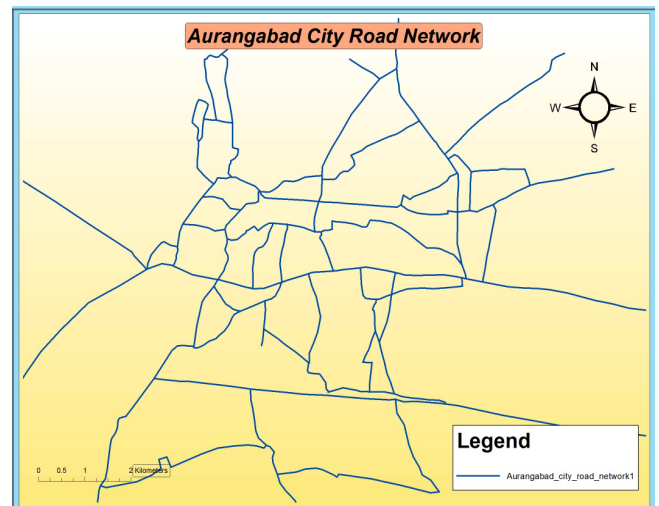


Figure 3: Aurangabad City Road Network using ArcGIS

Following are the pitfalls in the transportation system of Aurangabad city [13]:

- No bus route network was defined.
- Narrow road network.
- Unplanned bus stop location.
- Lack of parking area.
- Long travel time & low passenger trips.
- Area restriction.
- Insufficient number of staff and buses.
- Poor social awareness.

B. Private Transportation

This mode of transportation is increasing day by day in Aurangabad city. There are various issues which cause tremendous rise in the private transportation. Which mainly point out to drawback of public transportation system. Reasons why public transport is not favorable:

- Long waiting time.
- Long walking distance.
- Buses Not on time.
- No space, congested
- High cost
- Increase in Individual income.

V. SCOPE OF THE STUDY

Transport system planning with the vision Aurangabad as a smart city is as follows [25]:

- Develop a transport system and traffic management.
- Define a structural road network with road numbering.
- Analysis of bus stop and their positions.
- Mapping of bus stop according to rules.
- Map bus stop location with sufficient parking area.

VI. DIFFERENT TECHNIQUES FOR NETWORK ANALYSIS

There are various methods for network analysis, and most of the work is concentrates on finding shortest routes, accessibility of the network, and connectivity of the network with respect to route distance, speed, spatial locations, and time. In the network analysis, selection of method depends on the research objective. Comparison of two or more networks can be done using some methods with respect to their accessibility and connectivity. For the network analysis of any area, it is necessary to have knowledge of population density, network connectivity and accessibility [11][14][24].

In ArcGIS, we have following options as:

- a) Douglas-Peucker (DP) algorithm
- b) Vehicle Routing Problem (VRP)

A. Douglas-Peucker Algorithm:

This algorithm was most popular algorithm, which was used in many applications like Road, river, coastal line generalization. The following operations are required to generalize a road network [14].

1. Classification: It identifies an object and makes groups according to properties. For easier selection and more accurate roads depends on the good classification. It minimizes the complexity. Ex. Road width.
2. Selection: Select particular road class on the target scale.
3. Elimination: Eliminate shorter road of a certain length.
4. Simplification: selected roads can be simplified to reduce the details. Ex. Remove extraneous bends of roads.
5. Typification: This is manual editing approach. It reduces the Network density and simplifies the distribution and the pattern of the network. It reduces network congestivity.
6. Symbolization: To represent features on maps, graphic marks are used. Ex. Road Name, Road Number [14].

B. Vehicle routing Problem:

The Vehicle Routing Problem (VRP) can be explained as the problem of designing an optimal path or collection routes from one or several locations or stops

for a number of geographically spread passengers, subject to different constraints such as a time bound, capacity etc. [15][16]. The vehicle routing problem lies at the heart of distribution management [17]. It is faced each day by thousands of companies and organizations engaged in the delivery and collection of goods or people [18][19][20].

VRP plays important role in the physical distribution of passengers and its management [21].

It finds best vehicle route(s) to serve number of passengers from multiple bus stops [22].

Best route may be

- Minimum distance,
- Minimum cost
- Minimum travel time [20].

Definition: Let $G = (V, A)$ be a graph where $V = \{1, 2, \dots, n\}$ is a set of vertices representing bus stops and chowks located at vertices, A is the set of arcs. With every arc (i, j) $i \neq j$ is associated a non-negative distance matrix $C = (c_{ij})$. In some cases, c_{ij} can be interpreted as a travel cost or as a travel time [16][18][23].

The VRP consists of designing a set of least-cost vehicle routes in such a way that [16][22]:

- (i) Capacity limit: a non-negative demand d_i is attached to each stop $i > 1$ and the sum of demand of any vehicle route may not exceed the vehicle capacity. Capacity-constrained VRPs will be referred to as CVRPs.
- (ii) The number of stops on any route is bounded above by p (this is a special case of (i) with $d_i = 1$ for all $i > 1$ and $D = p$),
- (iii) Total time limit: the length of any route may not exceed a prescribed bound L ; this length is made up of route travel times c_{ij} and of stopping times t_i at each stop i on the route. Time or distance-constrained VRPs will be referred to as DVRPs,
- (iv) Time windows: stop i must be visited within the time interval $[a_i, b_i]$ and waiting is allowed at stop i .

By using these algorithms we can find out shortest route with respect to distance, spatial locations, speed and time.

CONCLUSION

Geographical Information System in urban transportation planning has become widely popular in recent years. Study of the existing transportation system of the Aurangabad city shows that there is a need for improvement in the management of the current transportation system. By using different techniques for network analysis we can simplify transportation with respect to distance, time and accessibility. There is need to map bus stops and auto stops according to some rules by considering the feasibility conditions. Use of GIS in this field help us to plan, analyze and to make decisions in an efficient way.

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