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A GIS Based Traffic Congestion Evaluation For Coimbatore City

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Abstract : The emergence of traffic and subsequently traffic congestion in urban road networks are increasing worldwide with the growing number of vehicles, which results in excess delays, and reduced safety. The aim of this paper is to use many GIS functions (network analyst, Overlay Analysis, Kernel Density) to evaluate the spots of traffic congestions during working hours and day. The study area selected is Combatore in the state of Timil Nadu. The results are utilized in evaluating congestion spots and diverting the traffic to newly suggested roads to reduce the congestion.

Keywords: GIS, Traffic congestion, Network analyst, Overlay Analysis, Kernel Density.

1.0 Introduction

A transportation system should satisfy the perceived social and economic needs of the user, as the need changes transportation system itself evolves and problems occur if it become inadequate. The critical problem that an urban area faces is the traffic congestion which occurs when the demand exceeds the capacity. The main cause of congestion is oversaturation and the situation worsens if an incident occurs. General congestion management measures include a wide range of data collection, system monitoring, identifying and evaluating transportation control measures. These types of measures and management can be done effectively with the help of latest advancements in GIS and GPS. With the speedy improvement in road infrastructure of developing countries, urban traffic is continuously increasing. A country's transportation system represents development stage of country. But at the same time highly developed countries are facing higher problems of transportation management and spending lot of money and efforts for solving those problems. The application of GIS to a diverse range of problems in Transportation engineering is now well established. It is a powerful tool for the analysis of both spatial and non-spatial data and for solving important problems of networking. Shortest path analysis is an essential precursor to many GIS operations.

1.1 Study Objectives

The objectives of this study are:

- To determine the various factors that influences traffic congestion.
- To estimate the congestion spots using the model developed.
- To use GIS as a tool for effective dissemination of congestion and management.

1.2 Study Area

The study area selected is Coimbatore in the state of Tamil Nadu. Coimbatore is the second upcoming smart city in India and is called as Manchester of South India. The longitude of Coimbatore lies between 76°65' $E - 77^{\circ} 29'$ E. The latitude lies between 10 ° 22' N - 11 ° 41' N. The total area of Coimbatore corporation is 471 square kilometres.



Figure 1: Study Area

2.0 Literature Review

Gil.N and Bharath.B.D.et.al¹ reported that GIS permits users to display information geographically It can also provide a common link between two or more previously unrelated databases. Anita Selvasofia. S.Det.al²reported that Transportation System Management (TSM) measures one needs to have a clear view of the flow patterns, locations, as well as existing road network. An attempt was made to find solutions to reduce the traffic congestion using SPSS16 and to identify and rectifying the problems using a GIS based model. PankajaM.N.and Anantha Rama.V³carried out a a similar study, and repoted that incorporating GIS in a pavement management program improves the reporting and analysis of data through the production of maps and graphic displays..Reshma.E.K. and Sheikh Umar Sharif ⁴described the development of a safety Evaluation Method for a Local Area Traffic Management (SELATM), which is a GIS based program for analyzing accident patterns over time and the evaluation of the safety benefits. This was proven by B.K.Baniket. Al.⁵ when they proposed to use GIS to obtain statistical and spatial analyses of roadway characteristics such as safety, congestion level and pavement conditions. In a separate study by Nilesh Deshpande et.al⁶, the capabilities of GIS in providing a framework for a management system were demonstrated once again. It highlighted the fact that many transportation analysts reap benefits from improved access to data. J.Aldridge.et.al⁷ developed a GISbased traffic accident information system for Kent County, Delaware. Ganeshkumar and Ramesh.D⁸developed a detailed GIS database of transportation network, accident locations, hospitals, ambulance locations, police and fire stations and carried out Spatial analysis for accident records of years 2004 - 2008 using ArcGIS9.3 to map the accident risk zones. DeepthiJayan.K and Ganeshkumar.B⁹includedaccident particulars like date, location, type of vehicle involved, number of persons injured or died are included in the GIS database. Based on the result, suggestions were provided to reduce the accidents in the future. Uraon, M. Parida K. and Ghosh S.K. ¹⁰analysed five years of police records and found that nearly 72% of accidents lead to fatal and grievous injuries. Cars, jeeps and vans are mostly responsible for accidents and that the occurrence of accidents was mostly concentrated between 2PM to 10PM. Josphat K. and Mwatelah Z.¹¹suggested method to alleviate the problem of road traffic accidents through the inclusion of new technologies in developing countries, so that proper

decisions can be taken to precisely to reduce the occurrences of road traffic accidents. Anitha Selvasofia.S.D and Prince Arulraj.G¹²highlighted that safety and highway improvement programs hinges on the accurate and reliable analysis of traffic accident data The remedial measures are implemented in those accidental locations the incidents of accident may be reduced. Anitha Selvasofia.S.D and Prince Arulraj¹³develop a model Identify the prone locations using GIS. Remedial measures and provisions for traffic safety wassuggested for reducing the risk of accidents in blackspots.

3.0 Methodology

The open series Road network map which is available in the survey of India web site was digitized to suitable scale to implement the GIS based model. The factors identified as the causes for traffic congestion and accident are as follows

- Road Way
- Road Category
- Drainage facilities
- River Bank
- Bridge
- Traffic Signal
- Manned Traffic Signal
- Land use and Land cover
- Traffic Volume Data
- Live Traffic
- The map containing the desired road network was Scanned and given as to Arc View for digitizing.
- The road network was digitized with due considerations for separation of every link and id numbers were assigned to every link.
- The road attribute table generated was exported in dbase format so that it can be imported by Arc view.
- The road attribute table was joined with the digitized road map and the road network was for accident occurrence using total weights assigned to every link.

4.0 Analysis

4.1 Overlay Analysis

Overlay analysis is a group of methodologies applied in optimal site selection or suitability modeling. It is a technique for applying a common scale of values to diverse and dissimilar inputs to create an integrated analysis. The factors such as Road Way, Road Category, Drainage facilities, River Bank, Bridge, Traffic Signal, Manned Traffic Signal, Land use and Land cover, Traffic Volume Data and Live Traffic are converted into raster to perform the overlay analysis. The red colour indicates the very high congestion zones, Yellow indicates the High congestion zone, Pink indicates the Medium congestion, Green and violet indicates the low congestion zones. The output of the overlay analysis is shown in Figure2.



Fig 2 Traffic Congestion in NH & SH

4.2 Causes of Traffic Congestion

From Overlay analysis and data obtained from various agencies such as transport department, corporation, Police etc it is found that other major causes of traffic congestion include: poor driving habits, work zones, inadequate road capacity, lack of parking facilities, poor traffic control/management, presence of heavy vehicles, road side parking, special events, reluctant to use parking facilities and bus stop, poorly designed junctions/roundabouts and lack of efficient public mass transport system.

4.2.1 Selection of Suitable Place for implementing New Road, Widening, & Extensions

In order to reduce the traffic congestion, it is planned to introduce few links in the existing road network and to widen the existing roads so that a ring road can be formed to reduce the number of vehicles entering into the corporation area. An overlay analysis was carried out to find suitable places for widening the existing roads, locations for new roads etc. The Land use and Land cover, Soil Map,Geomorphology Map, Geology Map were given suitable weights find suitable Places for implementing New Roads, Widening andcarrying out Extensions. The red colour indicates the Very High congestion places, i.e. Saravanamaptty, Saibaba Kovil Junction Kovudampalayam and Ukkadam. The place suitable for widening of roads are shown in Figure 3.



Fig 3 Suitable place for Widening of roads

4.2.2 Formation of Ring Road

In order to identify the locations for the formation of ring roads ab Overlay analysis was carried out using the themes given in Table 1

Table 1 Themes and Weights for Overlay Analysis

Category	Classes	Weight Assigned
Land use and Land cover	Agriculture and Water Bodies	1
	Airport	2
	Open Land	3
	Settlement (Commercial)	6
	Settlement (Residential)	7
Geomorphology	Hills & Plateau	3
	Predominant Zone	2
	Plains	1
Geology	Gneiss	1
	Metamorphic Rock	2
	Unconsolidated Sediments	3
Soil Map	Deep Moderately well drained	1
	Loamy soil	2
	Shallow, well drained, Moderately	3
	Eroded	

	1-2	Easy
Reclass	2-4	Medium Risk Zone
	4-6	High Risk Zone
	6-9	Very High Risk Zone

Based on the analysis, it is found that Ring Road road could be laid near Sugunapuram on Coimbatore-Palakkad road that would reach Narasimmanacikenpalayam through Kuniyamuthur, Sundakkamuthur, Perur, Theethipalayam, Vadavalli and Pannimadai. The Wideningand Extensions workdoes not require relocation of a large number of people living along the proposed route that only very few houses would have to be demolished during the Construction. Once the road is laid, people from Kerala driving to Mettupalayam or Nilgiris can reach Mettupalayam without entering Coimbatore. At present they enter the city through Palakkad Road at Ukkadam and have to negotiate the traffic before reaching Mettupalayam road via Brookebond road. On this route, it takes at least 30 minutes for the motorist to cross the city. But once the eastern ring road is laid, they can reach Mettupalayam road directly from Sundakkamuthur that will result in a saving of about onr Hour.



Fig 4 Formation of Ring road

5.0 Conclusions

Methodology for modelling traffic congestion and finding solutions to minimize traffic congestions includes various steps. A GIS based model has been developed to model the traffic congestion. From the Overlay analysis, locations for widening of roads and locations for the formation of new roads so as to have a ring road around Coimbatore corporation were identified. The proposed strategy will definitely reduce the traffic congestion time required for those who have to bye pass Coimbatore city to reach their destination. Since the traffic congestion is reduced, the accident rate also can be reduced.

6.0 References.

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