GIS Based Route Optimization for Effective Traffic Management

M. Sureshkumar, S. Supraja, R. Bhavani Sowmya

Abstract— **Route optimization is one of the important requirement for proper traffic management in cities. The spatial analysis technique using by Geographical information system (GIS) plays a vital role in route optimization. Route optimization doesn't mean only shortest path, but it will also increase the maximum utilization of the route in a proper way. The necessity of utilization of advanced technique in traffic management is essential. In this study, the traffic volume survey was conducted in all important locations where the transit system fails to fulfil its requirement in the study area. Global positioning system (GPS) was used to collect the spatial location information. Satellite image was used to create base map and other thematic maps. The causes for transit problem was identified and the alternate routes are suggested by using GIS analysis.**

Index Terms— **Traffic management, GIS, GPS, Traffic volume study**

I. Introduction

A. General

Traffic management is one of the tough task of the local authorities due to rapid urbanization. Improper traffic management and planning may lead to severe traffic congestion and accidents in the city. Developing countries like India traffic management is based on past experience. Adopting of recent technologies in traffic management is essential for managing the current traffic scenario. GIS plays a vital role in solving traffic management problems. GIS applied to determine the public transport accesses level [1]. GIS is one of the powerful tools for analysis the spatial and attribute data for effective traffic management. Regional planning is essential for proper transportation management [2]. GPS data was used to identify the spatial location of traffic congestion and other location based spatial information.

B. Need for the Study

The present traffic scenario in the study area is needed to be upgraded due to severe traffic congestion, delay in travel time even in short distance, air pollution, etc., the traffic volume study is essential to understand the present situation and to take necessary steps to manage the situation. Adopting the GIS analysis technique may support the effective traffic management and also it may full fill the road user need.

C. Objectives of the Study

- To identify the traffic volume at congested locations in the study area.
- To develop a GIS database for the traffic volume.
- To determine the alternate routes for effective traffic management.

II. Literature Review

The literature review was done on various topics which related to traffic management, traffic congestion modelling and application of GIS in traffic management.

III. Materials and Methodology

The following materials and methodology was adopted for the study:

- Preparation of base map
- Identification of traffic congested location
- Collection of traffic volume data
- GIS analysis
- Identification of new routes

The base map was prepared by using high resolution satellite image. Reconnaissance survey was conducted in the study area to identify the locations where traffic problem is occurring. Based on the field study three locations are identified in the traffic volume survey. The collected data are incorporated in GIS platform. Implementation of advanced technology is adopted in public transportation [3]. GIS analysis was carried out to identify the alternate routes in the study area for effective traffic management. GIS was implemented in public transport composite social need index in Jeddah [4].

A. Study area

Kanchipuram is one of the famous tourism locations in South India. The aerial coverage is 36.14 Sq.km with a population of 2.32 lakhs (Census 2011). The city is located 75 km from the state capital Chennai. Past few decades Kanchipuram is one of the city where rapid urban growth is happening in India. Due to the development of more industries and educational institutions in and around the study area leads to a drastic increase in urban growth. In Kanchipuram city traffic congestion has been increased due to the increase in vehicle growth.

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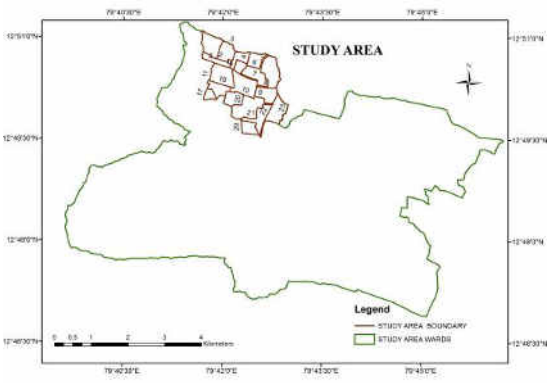

Fig. 1 Study area location

IV. DATA COLLECTION

A. *Reconnaissance Survey*

Reconnaissance survey was conducted in the study area during peak hour traffic. It has been observed huge traffic congestion and travel time delay happening in few locations. By using a handheld GPS device the coordinate of those locations are captured. GIS analysis can be used for public transportation accessibility [5]. The collected GPS data were transferred to the GIS platform for further analysis. Based on the reconnaissance survey three locations in the study area are identified in the traffic volume study, namely bus stand, Chennai road and katchapeshwarar temple junction.

B. *Traffic volume survey*

The traffic volume survey is conducted on the three locations by using CCTV footage. Vehicles in the traffic volume survey are included two wheeler, three wheeler, light motor vehicle (LMV) and heavy motor vehicle (HMV). The traffic volume survey was conducted on 23rd January 2017 and vehicle count is mentioned in the graph for each location. Based on the GIS analysis route optimization is possible [6]. The traffic volume data at the bus stand junction is shown in Table1 during the data collection period.

Table 1: TRAFFIC VOLUME DATA IN BUS STAND JUNCTION DURING 23.1.2017

LOCATION	BUS STAND	Latitude 12°50'13" N	Longitude 79°42'14"E	
23/1/17	Two wheeler	Three Wheeler	LMV	HMV
6.56-8.24AM	58742	2783	837	255
8.24-9.32AM	35977	1564	1693	142
9.32-10.35AM	54248	2368	1469	125
3.04-4.08PM	47638	1095	598	107
4.08-5.11PM	57339	1408	1319	127
5.11-6.14PM	59174	1536	1018	127
6.14-7.52PM	76433	1829	963	171
7.52-9.20PM	87567	3984	765	183

It has been identified the two wheeler count is more comparable to other vehicles in this location. Comparing with forenoon the traffic volume is heavy during evening time. Advanced techniques can be effectively used to analysis the critical transportation issues [7]. The graphical representation of traffic volume of bus stand junction is shown in Fig. 2. During 7.52 to 9.20 pm two wheeler volume is more in the bus stand location.

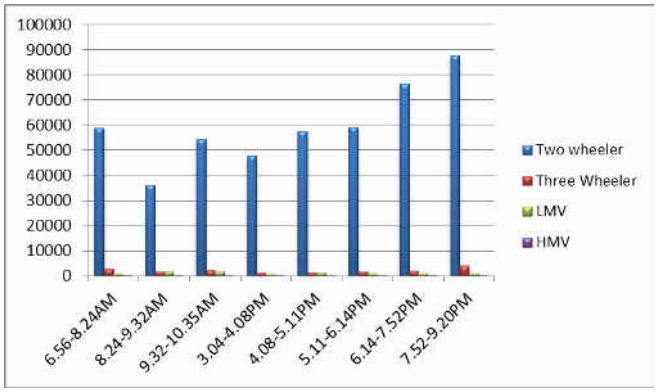

Fig. 2 Traffic volume graphical representation at bus stand junction

Chennai road junction is another important location in the study area where more traffic is more. The traffic volume data are shown in Table 2 of Chennai road junction.

Table 2: TRAFFIC VOLUME DATA IN CHENNAI ROAD JUNCTION DURING 23.1.2017

LOCATION	CHENAI ROAD	Latitude 12°50'32" N	Longitude 79°42'10"E	
23/1/17	Two wheeler	Three Wheeler	LMV	HMV
6.34-7.35AM	982	97	242	106
7.35-9.16AM	1803	467	516	477
9.16-10.40AM	1634	397	512	534
3.15-4.53PM	1498	446	612	452
4.53-6.30PM	1798	533	701	386
6.30-7.45PM	1718	488	721	435
7.45-8.20PM	1597	396	635	427

It has been observed in Chennai road junction mixed traffic flow is there. The graphical representation of Chennai road junction traffic volume is shown in Fig.3.

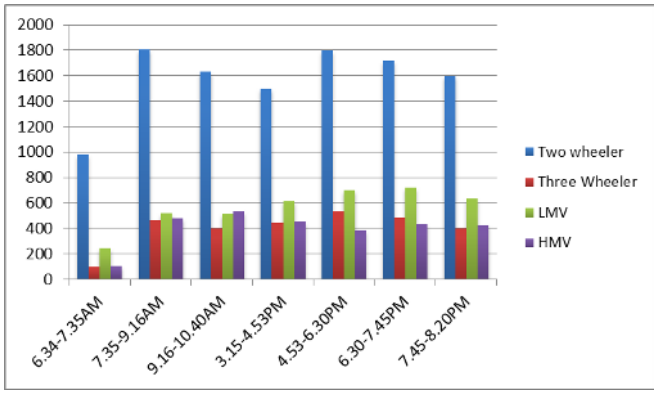

Fig. 3 Traffic volume graphical representation at Chennai road junction

The third location where the traffic volume survey was conducted is at katchapeshwarar temple junction (KTC). The

traffic volume data at this junction is shown in Table 3 and the graphical representation of the data is shown in Fig.4. GIS based transportation analysis result will useful for strengthening the traffic management system [8].

Table 3: TRAFFIC VOLUME DATA IN KTC JUNCTION DURING 23.1.2017

LOCATION	KTC Junction	Latitude 12°50'19" N	Longitude 79°42'05"E	
23/1/17	Two wheeler	Three Wheeler	LMV	HMV
7.18-8.53AM	3223	341	506	357
8.53-9.46AM	2874	352	583	396
3.00-5.00PM	5368	1396	1112	22
5.06-7.36PM	5478	1438	1128	17
7.36-9.18PM	5435	1233	1041	14

It has been observed two wheeler volume is more in the junction. Particularly at evening time the density of two wheeler is more. Next to two wheeler, three wheeler volume is more in this junction.

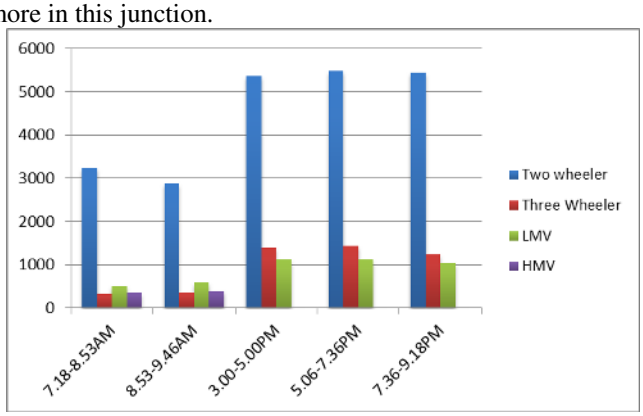

Fig. 4Traffic volume graphical representation at KTC junction

V. SPATIAL ANALYSIS

Spatial analysis is carried out for the traffic volume data. The collected traffic volume is incorporated as an attribute table in each junction in GIS platform. Arc map 10.1 software was used for spatial analysis. Spatial analysis is essential for identifying the proper traffic management [9]. Based on the analysis result four alternate routes are suggested in the study area for effective traffic management. The proposed route is suggested for HMV to reach the bus stand. The proposed route from Kanchipuram to Pondichery is shown in Fig. 5. By adopting this route from Kanchipuram bus stand to Pondichery, vandavasi, Cheyyaru, Dindivanam and Thiruvannamalai HMV are diverted through this route. Predicting future development of the city is essential for proper town planning [10].

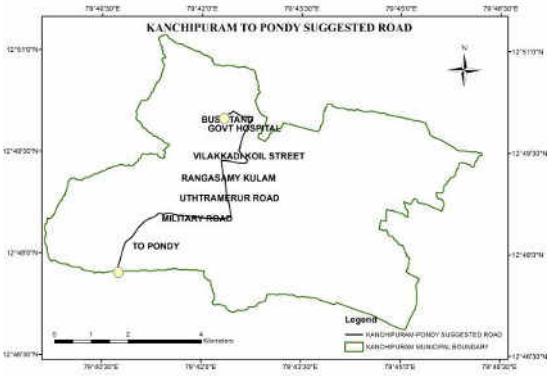

Fig. 5 Proposed route from Kanchipuram Bus stand to Pondicherry

From Kanchipuram bus stand to Vellore (Fig. 6) and from Vellore, Chennai to Kanchipuram bus stand (Fig.7) is also new route suggested. GIS based transportation result will be useful for economic development [11]. Utilization of this new route will improve the transit service in Kanchipuram city. Modelling of the transportation network is possible by using GIS [12].

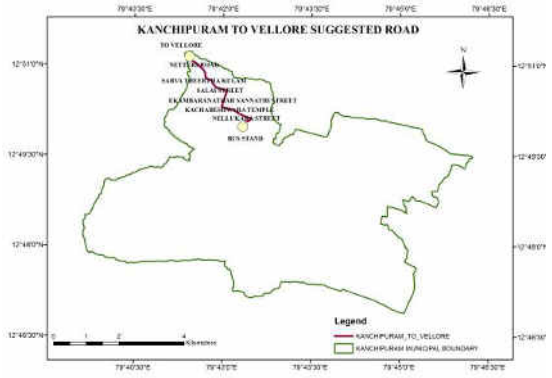

Fig. 6 Proposed route from Kanchipuram Bus stand to Vellore

Fig. 7 Proposed route from Vellore, Chennai to Kanchipuram Bus stand

The HMV intensity is more toward Kanchipuram to Chennai route. The proposed route for this route is shown in Fig. 8 for proper traffic management.

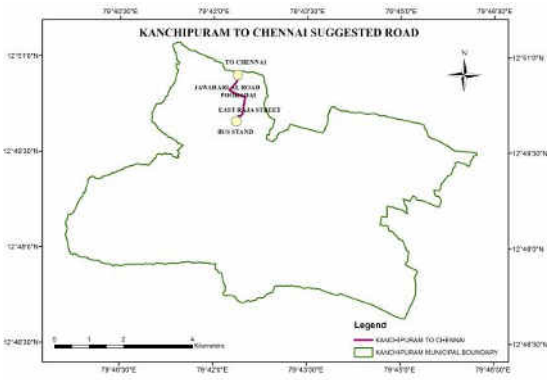

Fig. 8 Proposed route from Kanchipuram Bus stand to Chennai

VI. CONCLUSION

This study identifies the present traffic volume in Kanchipuram city. Based on the traffic volume study the dominant vehicle type in the city is understandable. The new routes are proposed for HMV. The adoption of new routes in the study area may be useful to increase the transit service and also helpful for proper traffic management in the study area.

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