Managing Traffic Congestion Using GIS – A Case Study in Attingal Town

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Abstract: **Traffic congestion is one of the major problem faced by most of the developing towns and cities. Various factors influence the speed of vehicles on the road. Mapping out these factors can help in the assessment and management of traffic congestion. In this paper, QGIS software has been used to determine roadside friction points that impact the vehicle speed on Attingal town in Trivandrum district. Allotting a new parking space is found out to be the solution for the studies conducted.**

Keywords: Congestion Management,QGIS ,friction points ,parking survey , GPS tracking

1. INTRODUCTION

Geographic Information System (GIS), over the years, has emerged as one of the efficient technological tools in the field of transportation engineering. It has shown great applications in a number of fields including transportation. The various advantages of GIS make it an attractive option to be used to face the emerging traffic problems. The advantage of GIS can be attributed to its capability to cope with the large volume of data with geographic spatial characteristics. GIS has a large database storage capacity, which can integrate data from disparate sources. While working with traffic speed, integrating spatial and non-spatial data from different sources becomes a prime concern. Moreover, along with great data integration capabilities, it is also a great visualization tool as it produces relevant maps assisting in decision making process.

There are various influencing factors that affect the speed of vehicles on the road, such as width of road, structure of the road, construction work on roads (e.g. work undertaken for Metro Rail construction); various land uses that attract motorized / pedestrian traffic bound to hospitals, institutional, commercial area etc. Mapping out these factors using GIS capabilities can help in the assessment and management of traffic congestion.

Attingal is a municipality in the Trivandrum district in kerala state, India .It is the headquarters of chirayankeezhu taluk and the important government institution of the taluk such as the taluk office and treasuries are situated in Attingal town.It is in the suburb of the extended metro polytan region of Trivandrum.

Located 30 km north of Trivandrum it is the Largest and the most important town in Trivamdrum district after the capital. The Attingal junction is the major bottle neck on the national Highway between Kochin and Trivandrum the

people are affected by the lack of parking space and demand expansion.

OBJECTIVES OF THE STUDY

The present study was done with the following objective :
• To identify the roadside friction locations on varying widths of urban, arterials and sub-arterials in Attingal Trivandrum region.
• To predict influence of the friction points on the vehicular speed on urban roads.

LITERATURE REVIEW

The literatures review was done to find the various key parameters of congestion at traffic, existing methodologies that were adopted for congestion modelling and the existing GIS application in the area of management.

Kalaga Rao and Mohan Rao (2009) studied the application of GPS for traffic data such as travel time and traffic speed and they validated the GPS data by conventional methods and statistically validated the results of these parameters and found that the GPS data can be used for traffic studies without compromising the accuracy of the data.

Anitha selva sofia et. al., (2013) talks about traffic congestion, which is a condition on road networks that occurs by slower, and increased vehicular queuing. To study the effect of the Transportation System Management (TSM) measures, one needs to have a clear view of the flow patterns, location as well as existing road network. GIS can be effectively used to analyse the problems associated with transportation.

Amudapuram Mohan Rao, S. Velmurugan, and Arpita Chakraborty (2014) studed about Various factors influence the speed of vehicles on the road. Mapping out these factors can help in the assessment and management of traffic congestion. In this article, GIS has been used to identify various roadside friction points that impact vehicle speed on some of the urban arterials in Delhi.

STUDY AREA

Attingal has one of the highest road densities in Trivandrum.The major road include Kaniyakumari-Panvel Highway (NH66) along with SH46 and SH47 connecting the town to Klimanur and Venjarammodu, passes throught the town. SH 46 joins the town at Alamcode and SH 47 at Munumukku, which had a high traffic density. Owing to

improper development of rail based modes in Delhi, the city is heavily dependent on road based modes of transportation (87 per cent of the total trips performed in the city are made using road based transport systems).In the present study, one locations was selected at Attingal area, the locations are shown in Figure 1.
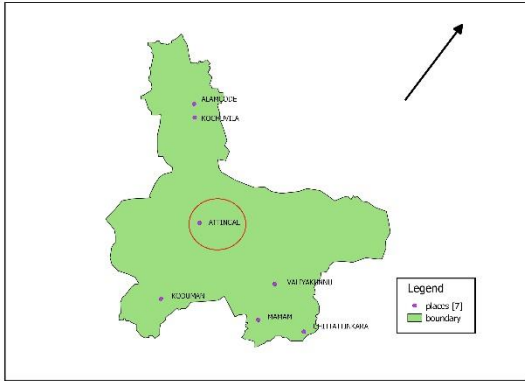

Figure 1: Study Area Map

Friction points

Friction factors are defined as all those actions related to the activities taking place by the side of the road and sometimes within the travelled way (like bus stops, unauthorized parking), which interfere with the traffic flow on the travelled way. They include but not limited to pedestrians, bicycles, non-motorized vehicles, parked and stopping vehicles, bus stops, petrol pumps on the side roads etc. These factors are normally very frequent in densely populated areas in the developing economies. In this study, initially friction point locations were identified on the selected road corridors and subsequently the influence of these factors on traffic performance measures were assessed. These friction points were identified by using GPS tracker and located by using graphical method.These points where plotted on map created using the QGIS software shown Figure 2.
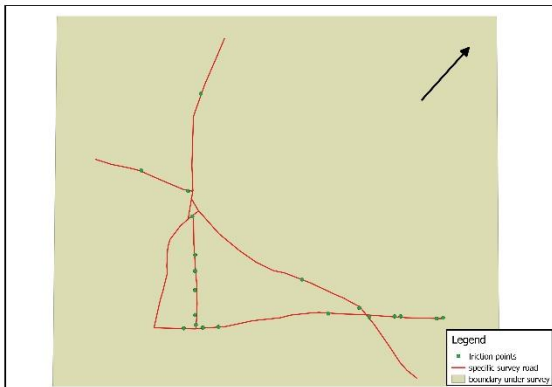

Figure 2: Map of friction points

METHODOLOGY

1.Identification of parameters which affect traffic congestion.
2. Selection of study corridor.
3. Collection of data
4.Map creation and analysis

DATA COLLECTION

1.Using Manual counters: It is the most traditional method.In this case trained observers gather traffic data that cannot be efficiently obtained through automated counts eg: vehicle occupancy rate, pedestrians and vehicle classifications. The most common equipment used are tally sheet, mechanical count boards and electronic count board systems.this was parking count was collected.

Table1:Parking Survey Data Monday(peak day one)

VEHICLE	9:30 AM	10:30 AM	5:00 PM	6:00 PM
CAR	117	143	211	242
TWO WHEELER	235	285	293	236
THREE WHEELER	22	32	35	23
HEAVY	11	7	18	3

Table 2:Parking Survey Data Friday (peak day two)

VEHICLE	8:30 AM	9:30 AM	10:30 AM	4:00 PM	5:30 PM
CAR	204	248	212	186	253
TWO WHEELER	351	397	324	347	406
THREE WHEELER	53	49	35	55	32
HEAVY	14	9	12	3	8

Table 3:Parking Duration

VEHICLE	LONG TERM PARKING
CAR	65-85
TWO WHEELER	180-220

2.Attribute Data: Non-spatial data has no specific location in space. It can however, have a geographic component and can be linked to a geographic location. The data on traffic speed was collected using the Performance Box wherein the probe vehicle fitted with GPS was deployed.
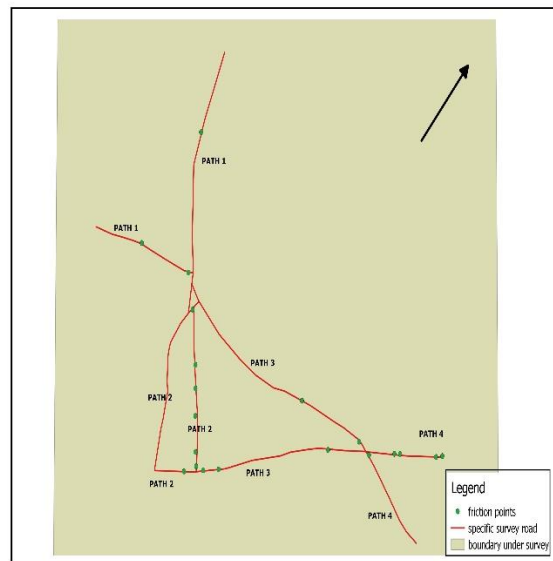

Figure 3: Path Map

Table 4: Typical Probe Vehicle GPS Data Path 1

LATITUDE	LONGITUDE	LENGTH	SPEED
8.69967	76.810963	78	19
8.69948	76.811784	167	20
8.69915	76.812585	266	22
8.69886	76.813339	352	20
8.69899	76.813518	391	14
8.69986	76.813586	484	21
8.70086	76.813627	600	24
8.70176	76.813804	703	21
8.70259	76.814216	806	28

Table 5: Typical Probe Vehicle GPS Data Path 2

LATITUDE	LONGITUDE	LENGTH	SPEED
8.69499	76.812544	81	23
8.69569	76.812644	172	24
8.69667	76.812878	353	27
8.69755	76.813105	384	26
8.69807	76.813632	410	10
8.69744	76.81367	501	18
8.69684	76.813693	539	9
8.69601	76.813741	590	2.84
8.69589	76.81374	646	2.38
8.69536	76.81373	711	17
8.69491	76.813721	736	3.1
8.69485	76.813714	768	0
8.6945	76.813366	821	5
8.69406	76.812682	899	15

Table 6: Typical Probe Vehicle GPS Data Path 3

LATITUDE	LONGITUDE	LENGTH	SPEED
8.69734	76.814629	87	26
8.69686	76.815293	177	28
8.69637	76.816531	326	38
8.69604	76.817392	425	0
8.69586	76.817858	483	23
8.69535	76.818647	583	5.98
8.6953	76.818224	636	22
8.6953	76.817418	730	14
8.6953	76.816959	780	26
8.69513	76.815979	790	25
8.69489	76.814808	1020	32
8.69479	76.814099	1100	16
8.69479	76.813589	1160	20
8.69482	76.812806	1240	14
8.69486	76.812592	1260	10

Table 7: Typical Probe Vehicle GPS Data Path 4

LATITUDE	LONGITUDE	LENGTH	SPEED
8.69314	76.820008	27	15
8.69311	76.82057	87	15
8.69343	76.820107	153	15
8.69391	76.819688	220	15
8.69433	76.81942	279	8.39

8.6945	76.8193	300	11
8.69496	76.819015	360	4.93
8.69502	76.818927	372	1.84
8.69511	76.818955	382	1.33
8.69513	76.818055	424	13
8.69512	76.81968	465	10
8.69513	76.820037	505	10
8.6951	76.820623	572	11
8.69513	76.820983	612	10
8.69506	76.82138	656	9

Map creation and analysis

The maps needed for the needed study was created using QGIS software. The base map was collected from the website of the land use board of Kerala. The boundary map of Attingal municipality ,The major and other road of Attingal municipality map ,Major location of Attingal municipality map and The map of specific study area was created.
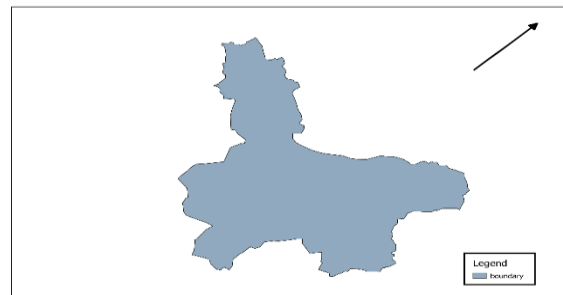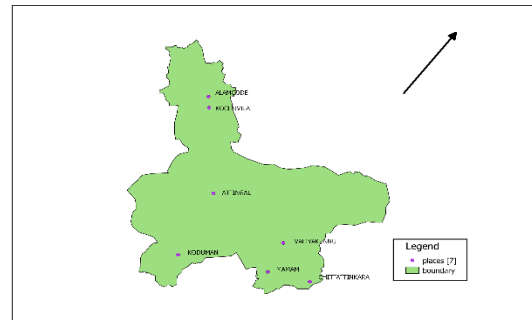

Figure 4: Boundary Map
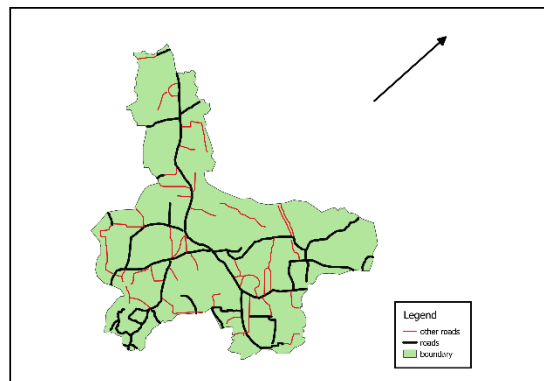

Figure 5: Major Location Map

Figure 6: Major roads and Other roads Map

Traffic speed data analysis

The traffic speed data analysis was done using data bases and the speed – length graphs plotted using the traffic speed data collected. This traffic speed data was collected as 4 parts. This was again transferred as points called friction points on the specific study area map .
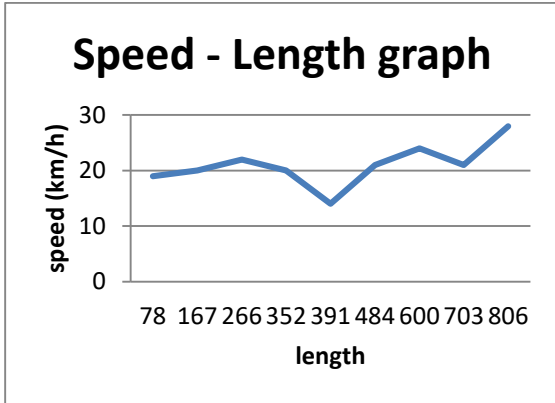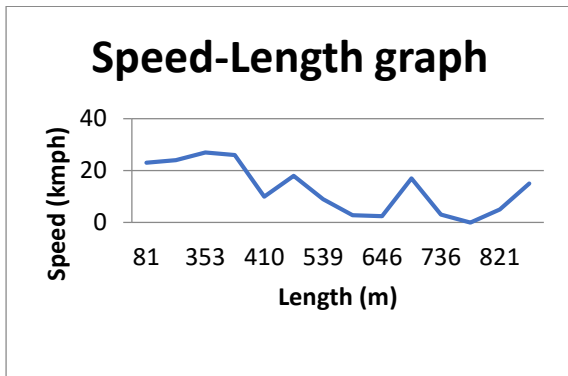

Figure7:Speed – Length graph Path 1
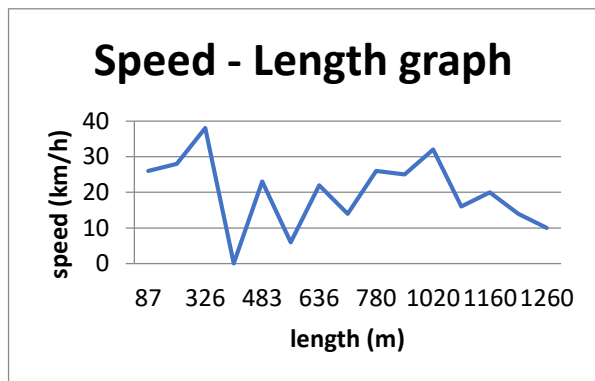

Figure 8: Speed – Length graph Path 2
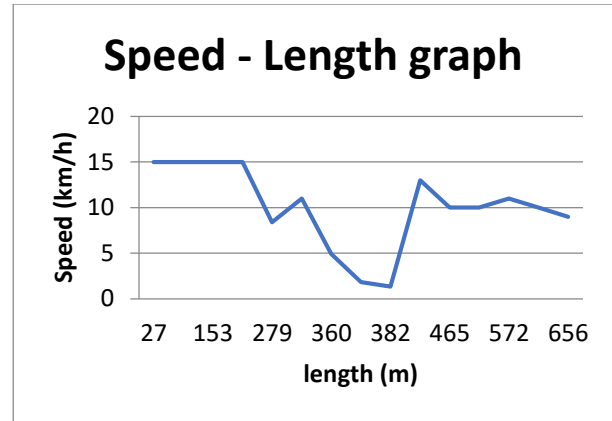

Figure 9:Speed – Length graph Path 3

Figure 10:Speed – Length graph Path 4

Identification of influence of friction points

One run on the study path at a peak period of time were plotted on a graph using the GPS tracker data to understand the variation in speed. The speed profile plot was plotted by depicting the absolute distance on the x-axis and variable speed on the y- axis.

The friction points are the points of minimum speed on the travel path taken at one run. These point are again plotted to the specific study area map to identify the point of friction and to make the reasons for the speed reduction.
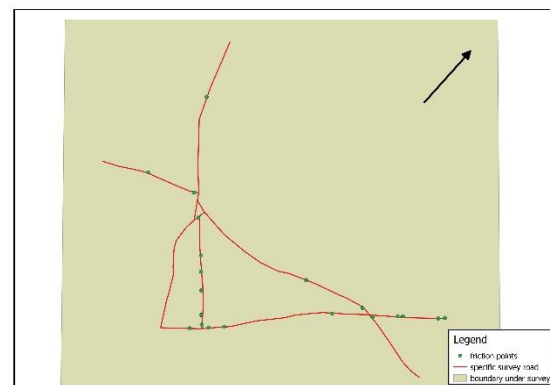

Figure 11: Friction Points Map

CONCLUSION

- The influence of the friction points on the traffic speed shows that the influence of the bus stops, school zone and junctions is up to 95% .
- This study observed that the impacts of the pedestrian crossing roads and parking of vehicles on the roads would have a negative influence on speed varying from 20% to 65% whereas the bus stops located without the proper provision of bus bays would reduce the speed of the vehicle to the tune of 25% to 40%.
- Parking was one of the major cause for the traffic congestion in the study area, so we suggest an effective parking system like multi level parking system on a convincing space with in the traffic congestion zone .

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