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IDENTIFICATION OF BLACKSPOTS AND ACCIDENT ANALYSIS USING GIS

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Abstract - *An accident black spot is a hazardous or high risk location where a number of accidents repeatedly occur. The identification, analysis and treatment of road accident black spots are widely regarded as one of the most effective approaches to road accidents. Frequent occurrences of accidents in the black spots can be attributed to varying factors. As a major share of the accidents occur in such black spots, measures should be taken to reduce the number of accidents in these spots to improve the overall road safety. The present study aims to find the major accident black spots in Kothamangalam and to identify various traffic parameters and road factors causing accidents. The capability of GIS to link attributes data with spatial data facilitates prioritization of accident occurrence on roads*.

Key Words: Accident black spots, GIS Applications, Weighted Severity Index (WSI), Passenger Car Units (PCU)

1. INTRODUCTION

Nothing is more important to civilization than transportation and communication and apart from direct tyranny and oppression; nothing is more harmful to wellbeing of society than irrational transportation system. Worldwide, the transportation problems faced by various nations have increased manifold, necessitating search for methods or alternatives that ensure efficient, safe, feasible and faster means of transport. It has been estimated that India currently accounts for nearly 10% of road accident fatalities worldwide. In addition, over 1.3 million people are seriously injured on the Indian roads every year. Hence, road safety is a very serious issue in India and needs to be addressed with utmost priority. In Kerala, the scenario is not different; there were 4145 fatalities and 25110 grievous injuries in a total of 39014 accidents in the year 2015 (Kerala Police, 2016).

An accident black spot is a hazardous or high risk location where a number of accidents repeatedly occur. The identification, analysis and treatment of road accident black spots is widely regarded as one of the most effective approaches to road accidents. Geographic Information System (GIS) is an effective tool to represent the black spots graphically. GIS integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information. The capability of GIS to link attributes data with spatial data facilitates prioritization of accident occurrence on roads and the results can be displayed graphically which can be used for planning and decision making. Accident –prone locations can be identified using GIS by analysing spatial characteristics about identified locations, and also able to figure out the underlying factors causing accidents. Then reasonable actions can be taken to improve safety in the accident-prone locations. In many developed countries, GIS has been widely used for analysing the accident prone locations or the accident black spots. Many academicians and even government agencies are working on building new tools and improving the existing scenarios for road safety analysis. In this study, GIS analysis is performed using ArcGIS 10.1 software. This paper includes pilot study of identification of accident black spots in the region of Kothamangalam using Weighted Severity Index method.

2. SCOPE AND OBJECTIVE

The objectives of the project are as following:

1. Identify locations which have both high risk of crash losses and justifiable opportunity for reducing the risk.
2. To implement a methodology for the identification and prioritization of hazardous road locations.
3. To find and represent the major accident black spots in Kothamangalam using geographic information system (GIS).
4. To identify various traffic parameters and factors causing accidents and suggestion of possible improvements.

3.STUDY AREA

Kothamangalam is a Municipality in the eastern part of the Ernakulum district in the Indian state of Kerala. It is around 14Km northeast of the town of Muvattupuzha and 55Km north east of Kochi city. The town is in the foothills of Western Ghats mountain ranges. The highway NH-49 Ernakulum-Madurai-Rameswaram passes through Kothamangalam

3.1 Physiography

Kothamangalam is known as the Gateway of Highrange. According to the division of geographical regions of Kerala to High-land, Mid-lands and Low-lands, Kothamangalam is in a Mid-land region. The general topography is hilly. The Munnar hill station is around 85 kilometres from Kothamangalam

3.2 Climate

The climate of the region is tropical humid, with temperature ranging from 20^{oC} to 32^{oC}.The hottest months are April-May and the coldest December-January. The region receives heavy annual rainfall of around 2500mm-3600mm.The rainfall is mainly concentrated from June to October. The South –west monsoon and Northeast monsoon bring rains to the region. Nerimangalam gets the highest rainfall in Kerala.So this place is known as 'The Cherrapunjee of Kerala'.

4.COLLECTION AND ANALYSIS OF DATA

Secondary data is the data collected initially. The data collection involves the collection of accident data of the district for the past three years from the concerned police department. Detailed analysis of secondary data was carried out for the identification of top black spots.

Primary data collection includes road inventory surveys, traffic volume count, collection of traffic parameters etc. The various traffic parameters and road characteristics from these surveys were given suitable weights and were used in the prioritization of spots using GIS.

4.1 Collection And Analysis Of Secondary Data

The last 6 years (2011, 2012, 2013, 2014, 2015, and 2016) accident database of Ernakulum was collected from Kothamangalam police station. Secondary data was the basis for the identification of major accident spots

4.1.1Ranking of Accident Spots

The accident spots obtained after the sorting and detailed analysis of secondary data were prioritized to arrive at the top accident black spots using Weighted Severity Index Method.

Weighted Severity Index (WSI) = (41 x K) + (4 x GI) + (1 x MI)

K, GI, MI are the number of persons killed, number of grievous injuries and number of minor injuries respectively. WSI values of all the selected spots were calculated. The top five spots with the highest value of WSI were chosen for the project study.

The top spots thus obtained are given table.1

Table -1:

RANK	PLACE	DEAD	G.I	M.I	W.S.I	NO.
1	Thankalam	9	51	22	595	71
2	Kothamangalam	2	46	30	296	71
3	Kozhipilly	4	27	8	84	31
4	Karukadam	4	21	12	260	30
5	Kuthukuzhi	4	11	7	215	19

Table – 2: Exact Spot Location

SI.NO	PLACE	DISTANCE(KM)	DIRECTION	ROAD
1	Thankalam	2	west	A.M road
2	Kothamangalam	1	west	O.R road
3	Kozhipilly	2	east	O.R road
4	Karukadam	5	south-west	N.H
5	Kuthukuzhi	4	east	A.M road

NOTE: Direction and distance is from Kothamangalam Police Station.

A.M Road: Aluva – Munnar Road

O.R Road: Other Road

N.H: National Highway

4.2 COLLECTION AND ANALYSIS OF PRIMARY DATA

4.2.1 Road Inventory surveys

Table – 3:

Place	No. of lanes	Width (m)	Road type	Surface condition	Drainage	Shoulders	Edge Obstruction	Median	Surface condition
Thankalam	1	7.3	SH	Good	Poor	No	Yes	No	Tiled
Kozhipilly	1	5.5	OR	Satisfactory	No	No	Yes	No	Bituminous
Karukadam	1	7	NH	Good	No	No	No	Yes	Bituminous
Kuthukuzhi	1	5.5	AM	Good	No	No	No	No	Bituminous
Kothamangalam	1	6.2	OR	Good	No	No	No	No	Bituminous

4.2.2.Traffic Volume

Traffic volume survey was conducted and three hour traffic volume count was taken for all the spots from (6-9) P.M(Since most accidents occurred between 6PM to 9PM) for three days and peak hour traffic in terms of Passenger Car Units (PCU) was found.

The road stretches considered were found to be carrying mixed traffic. The most frequent type of vehicle in most of the spots was light motor vehicles and two wheelers. The peak hour traffic volume values fall within the range 1000-5000 PCU.

Table – 4:

PLACE	PCU	FREQUENT VEHICLE TYPE
Thankalam	3553	Two wheelers
Kozhipilly	1983	Two wheelers
Karukadam	2246	Two wheelers
Kuthukuzhy	1548	Two wheelers
Kothamangalam	4268	Two wheelers

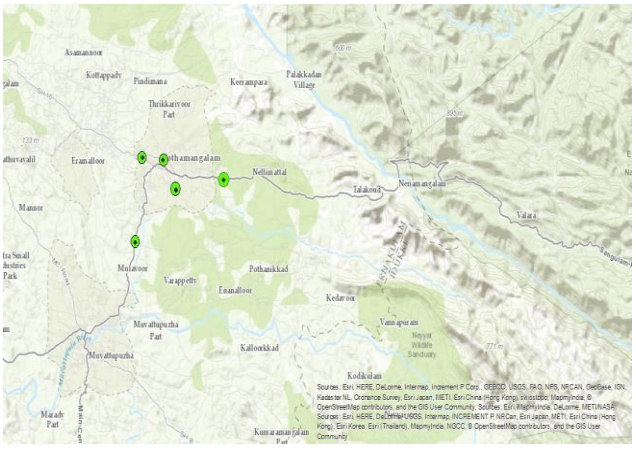
5.GIS ANALYSIS

GIS has been widely used for analysing the accident prone locations or the accident black spots.In this study, GIS study is performed using ArcGIS 10.1 Software.

5.1 MAPPING OF BLACKSPOTS

The top five accident spots in Kothamangalam were Plotted using ArcGIS 10.1. That is shown in the map given below (Fig 1)..

Fig 1 :



5.2.Prioritization Of Black Spots

Table – 5:

SL.NO	FACTORS	POSSIBE VARIATION	WEIGHT ASSIGNED
1	NO OF LANE	1	4
		2	6
		4	10
2	WIDTH OF ROAD	<6m	1
		6-8m	3
		8-10m	5
		10-12m	7
		>12m	10
3	ROAD TYPE	NH	1
		SH	4
		PWD	8
		OR	10
4	SURFACE TYPE	BITUMINOUS	4
		CONCRETE	10
5	SURFACE CONDITION	GOOD	10
		SATISFACTORY	6
		POOR	1
6	DRAINAGE FACILITY	GOOD	10
		SATISFACTORY	6
		POOR	2
		NO DRAINAGE	1
7	SHOULDER	PAVED	10
		UNPAVED	6
		NO DRAINAGE	1
8	EDGE OBSTRUCTION	YES	4
		NO DRAINAGE	10
9	MEDIAN	YES	10
		NO DRAINAGE	4
10	VEHICLE TYPE	HEAVY VEHICLE	10
		BUS/TRUCKS	8
		CAR	4
		TWO WHEELERS	1
11	NO.OF VEHICLE PER DAY	<10000	10
		10000-25000	7
		25000-50000	4
		>50000	1

$$\text{Total Weightage} = \frac{\sum \text{Individual Weightage} \times 100}{110}$$

5.3 Prioritization Scheme

Table – 6: Prioritization scheme

Final weight (%	Accident prone level
80-100	Very low
60-80	Low
40-60	Medium
0-40	High

The road characteristics as well as traffic parameters of each spot is specified as attributes and linked with each spot in the digitized road map. The various spots were then prioritized for accident occurrences using total weights assigned to every attribute, as a result of which the black spots were ranked on the basis of vulnerability.

Table – 7: Final weightage and accident prone level of each spot

Place	Weightage	Accident Prone Level
Thankalam	42.72	Medium
Kothamangalam	47.2	Medium
Kuthukuzhi	37.27	High
kozhipilly	40	Medium
karukadam	47.2	Medium

6.SUGGESTIONS FOR IMPROVEMENT

From detailed observations and analysis of each spot it was found that there is scope for improvements at each spot. Some suggestions for the possible improvements of the spot is made here.

- Provide median of 3m width. As per IRC 73 – 1980, the minimum recommended width of median is 3*m*.
- Take suitable enforcement measures to reduce the speed of vehicles.
- Parking regulation.
- Providing proper sign boards.
-

7.SUMMARY AND CONCLUSION

The study was an attempt to identify the most vulnerable accident black spots of Kothamangalam. Black spots are high risk locations were a number of accidents repeatedly occur. Black spot management is an effective approach to reduce the accident rates of a place. The Geographic Information System can be utilized efficiently for the analysis, prioritization and representation of Black spots.

The accident database of Kothamangalam for last six years were collected from Kothamangalam police department. The accident spots were then prioritized using weighted severity index method.WSI value of a place represents the hazardousness of the spot. Then top five spots with highest value of WSI were chosen for the study. All the identified spots were then visited and the accident scenarios were accessed.

In the next stage of the project, traffic as well as road inventory surveys of the selected spots were carried out. The required road characteristics and traffic parameters of the spots were obtained. For each parameter thus collected, weightage within the range of 0-10 was assigned such that least weightage was given to the factor that contributes least to the occurrence of accidents. All the spots then again prioritized in GIS using the prioritization scheme.

After prioritization in GIS, possible improvement measures were suggested for all identified spots.

8.REFERENCES

[1] Reshma E.K1, Sheikh Umar Sharif, September 2012,"*Prioritization Of Accident Black Spots Using GIS* "International Journal of Emerging Technology and Advanced Engineering, Volume 2, Issue 9.

[2] Apparao. G, P. Mallikarjunareddy, Dr. SSSV GopalaRaju*." Identification Of Accident Black Spots For National Highway Using GIS",* International journal of scientific & technology volume- 2, pp154-157.

[3]LiyamolIsen, Shibu.A, Saran M., 2013*,"Evaluation and treatment of accident black spots using Geographic Information System",* International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 8.

[4]Grant G. Schultz, Clancy W. Black and Mitsuru Saito, 2014, "*GIS Framework for Hierarchical Bayesian based Crash Data Analysis ",* ASCE, page 477-486.

[5]Jason Young, Peter Y. Park, 2014."*Hotzone identification with GIS-based post-network screening analysis",* Journal of Transport Geography, 34, pp 106-120.

[6]R.R.Sorate, R.P. Kulkarni, S.U. Bobade, M.S. Patil, A.M. Talathi, I.Y. Sayyad, S.V.Apte,2015,"*Identification of Accident Black Spots on National Highway 4 (New Katraj Tunnel to ChandaniChowk)",*IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE),Volume 12, Issue 3 Ver. I, PP 61-67.