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A Geospatial Overview of Road Traffic Collisions and Hotspot Analysis of Kerala

Manu .N. Nair[1], Dr. V. Thangamani[2], Ahmed Amirsha PV[3]
[1, 3] *Research Scholars,* [2] *Assistant Professor, Department of Geography, School of Earth and Atmospheric Sciences, Madurai Kamaraj University, Madurai, Tamilnadu , India*

Abstract: ***Road accidents have become one of the major causes of deaths in recent years. The global statistics shows that the numbers of deaths caused by traffic accidents are increasing day by day. It remains as a haunting health problem with an estimated amount of 1.2 million people killed worldwide annually. The world today is very much faster and they don't have time to waste, because of this reason they are developing new technologies which are much faster, and it is been mostly implemented on transporting vehicles. The increasing number of vehicles and road congestion due to population increase are considered as the major cause off road accidents, but apart from that carelessness of drivers and not obeying traffic rules can be considered more important than the above mentioned factors. Now the time has come when new technologies like GIS and GPS systems have to be installed in Indian vehicles too, which can in one way, reduce the number of accidents. Because of this prevailing situation studying accidents and identification of accident hotspots of various places have become the need for the present. The study area selected in this paper is kerala, one of the southernmost state of India. Kerala has recorded an immense increase in the number of accidents during the last five to six years. An attempt is made in this paper to demarcate fatal and non fatal hotspots of kerala and comparison of two time periods, which have been done for analyzing the changes and also the factors responsible for the accidents, suggestions and remedies are also suggested for the rectification and controlling accident in these black spots of kerala state and also an spatial pattern of road accidents have been analyzed with the help of various statistical tools and hotspot analysis of the collected data is also produced. All the results are analyzed and projected with the help of tools in ArcGIS 9.3.***

Keywords: Traffic collisions, Black spots, Fatal, spatial, Hotspot analysis, ArcGIS.

I. INTRODUCTION

Road accidents have definitely become one of the most important factors of human mortality. It is a multifactoriol public problem caused mainly by human errors. it has now become more hazardous than natural disasters. In India we have only 2% of road length of national highways out of total road length to accommodate 40% of the total traffic on Indian roads. This has resulted in a steep increase in number of road accidents fatalities in India which is alarming. Between 1970 to 2009, the number of road accidents increased by 4.3 times with more than 7 fold increase in injuries and about 8.7 times increase in fatalities in the backdrop of about 3 fold increase in road network. Around 56 road accidents take place every hour in which 14 deaths occurs on roads in India. There is a great need to take up measures that can help improve road safety in the country. Safety on roads has become a major area of concern. The number of persons killed in road accidents has increased considerably from during in the last decade. The road accident data in India during 2002-2009 has been given in Table 1.

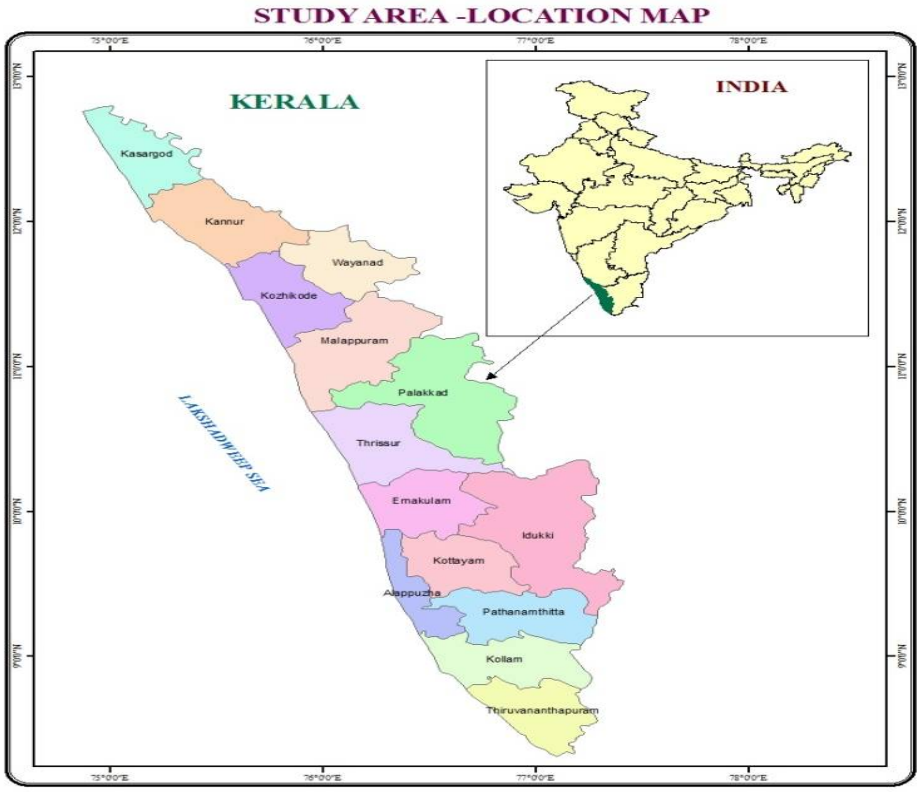
Table 1: Numbers of Accidents during 2002-2009 in India

Year	Number of Accidents	Number of persons killed
2002	4,07,497	84,674
2003	4,06,726	85,998
2004	4,29,910	92,618
2005	4,39,255	94,968
2006	4,60,920	1,05,749
2007	4,79,216	1,14,444
2008	4,84,704	1,19,860
2009	4,86,384	1,25,660

Over 1.26 lakhs people died in road accidents in 2009 as against 1.18 lakhs in 2008 and there has been a surge in the occurrence since, Over five lakhs accidents take place in India every year. In 2009, 1, 25,660 road accident deaths have taken place. The traffic management practices should be upgraded. Our designs permit speed but are not capable of handling it. It has now have become the nee of time to find solution for this crisis, I this aspect the most important ones are the hot spots where the rate of accident is comparatively more than the other regions. 6these places have to be demarcated and acute measures have to be taken respectively.

II. STUDY AREA

Kerala is a narrow, fertile strip of land on the southwest coast of India it is one of the smallest states in south in India It is on the tropical Malabar Coast of southwestern India. Tamil Nadu state is in east and Karnataka state is in north of Kerala. The location of the present study area is between latitudes 8 degree 18' north and 12 degree 48' north and longitudes 74 degree east 52' and 72 degree 22' east. Kerala is selected for the present study as it has become one of the major states where the road accidents rate is in a great pace compared to nearby states. The statistics shows that the number of cases is increasing day by day with lots of destruction to lives and properties.



III. OBJECTIVES

A. To compare two time periods of accident cases and analyze the changes.
B. To point out fatal and non fatal accident spots of Kerala.
C. To identify the factors responsible for the fatalities.
D. To provide suggestions and remedies for reducing fatalities in the accident spots.

IV. METHODOLOGY

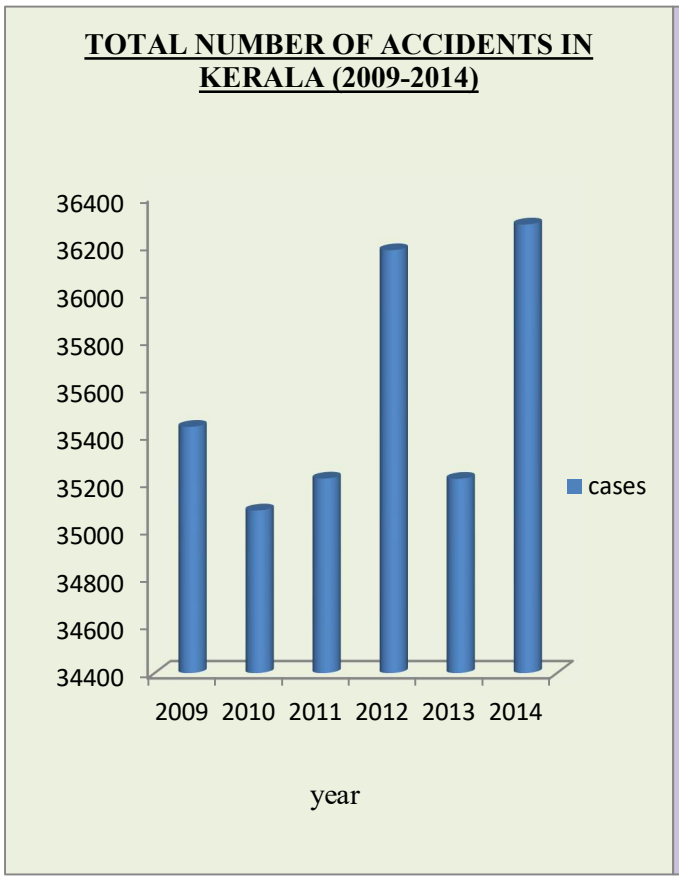
The present study mainly depends on secondary data .the data were mainly collected from motor vehicle department of Kerala, State Crime Records Bureau, Traffic Police Station, Pattom, Trivandrum, Kerala. The information's are also gathered from various articles and magazines. Data's are analyzed and projected with the help of simple statistical calculation and diagrams, all the results are tabulated. The main analysis is done with the help of Arc GIS 9.3 Software, spatial analyst tools are used in that interpolation IDW method is used to show fatal and non fatal accidents in the study area, the required maps are prepared and projected.

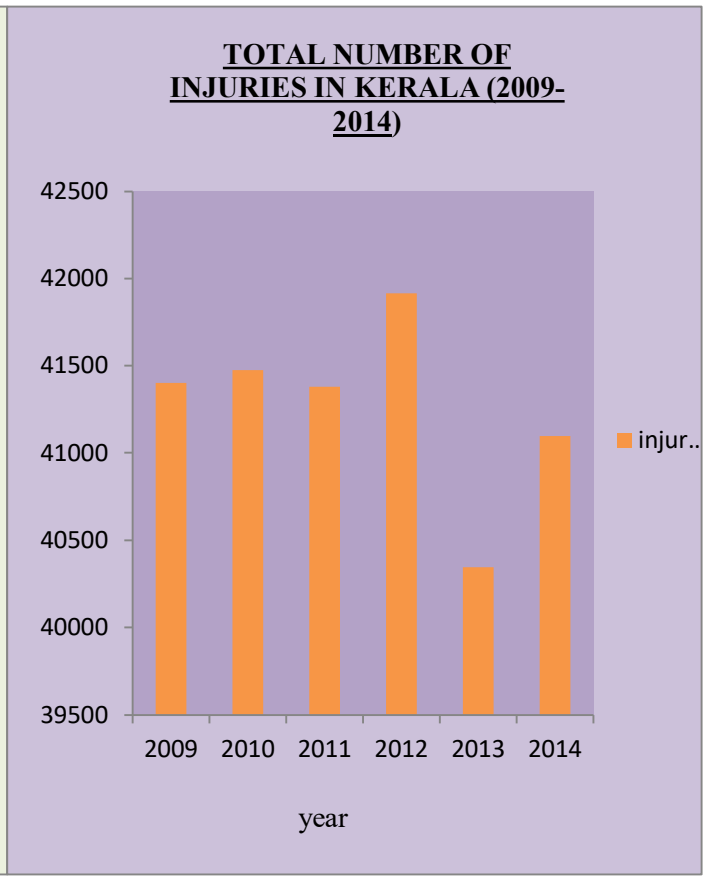
V. ANALYSIS AND RESULTS

Kerala is a state where the number of accident cases and the number of people losing their lives and loss of property is increasing day by day. The trend of this increase in road accident was started recently. The life lost in accidents is numerable in number. This is not only a big crisis for many families only, but also a big blow to our states development and growth. As per records around 600 Crore loss is recorded in Kerala due to road accidents. The number of registered vehicles is also increasing the possibility of more cases. Now in Kerala if we compare total road accidents of 2009 and 2014, there is a drastic variation in number of accidents and deaths. The total number of accidents in 2009 was 35433, this has increased to 36282 in 2014, an increase of 849 has been recorded. Ion the same way the case of number of people died has increased to 3831 in 2009 to 4049 in 2014. An increase of 218 is drastic. But in the case of injuries it has shown a decrease in numbers which is a positive sign. In 2009 the total number of injured was 41401 and it has reduced to 41096 in 2014. A decrease of 305 is recorded. (Table.2)

Table 2: Total number of road accidents in kerala from 2009-2014

year	cases	Deaths	Injured
2009	35433	3831	41401
2010	35082	3950	41473
2011	35216	4145	41379
2012	36174	4286	41915
2013	35215	4258	40346
2014	36282	4049	41096





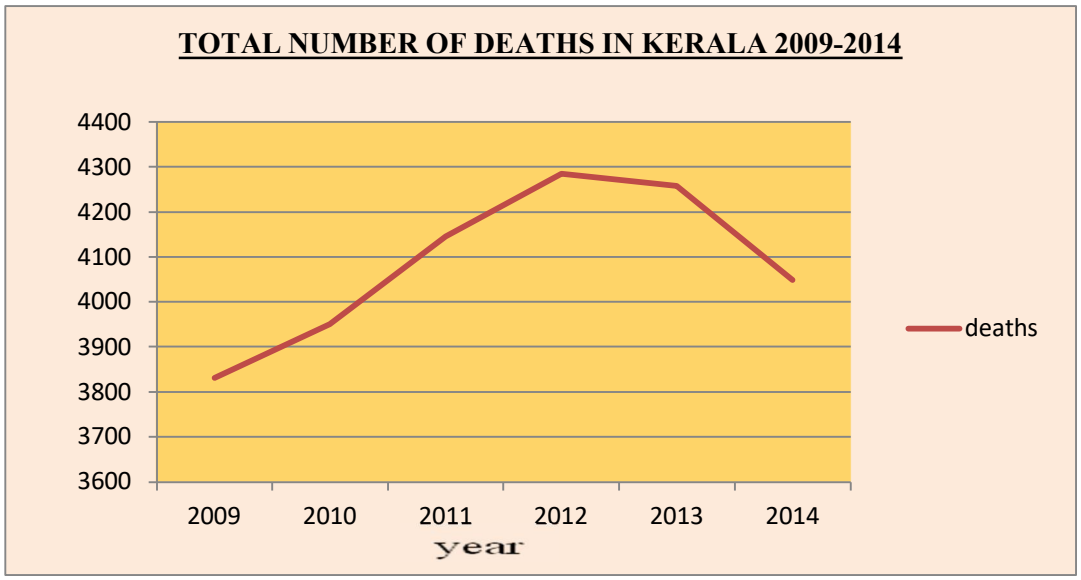


Fig. No.1

There are 14 districts in Kerala and the statistics of each district is well different from another. The table below shows the number of cases happened in the respective district during the two study points. i.e. 2009 and 2014. The whole Kerala is divided into three groups, district with high accident rate, district with moderate accident rate and district with moderate accident rate. The statistics are shown in the below tables.

Table 3: District with high accident rate

District	Deaths 2009	Deaths 2014	Injured 2009	Injured 2014
Trivandrum	407	522	4520	5304
Ernakulam	377	475	5096	6153
Alapuzha	333	367	3085	3266
Thrissur	343	417	4342	4454
Pallakad	301	331	2194	2460
Kozhikode	248	380	2468	2945
Kollam	296	374	2872	3208
Malapuram	284	357	3339	3305

Table 4:District with moderate accident

District	Deaths 2009	Deaths 2014	Injured 2009	Injured 2014
Kottayam	215	243	2773	2892
Kannur	167	201	1987	2083
Pathanamthitta	113	125	1308	1687

Table 5: District with low accident rate

District	deaths 2009	Deaths 2014	Injured 2009	Injured 2014
Idukki	83	87	1306	1167
Wayanad	56	69	802	721
Kasargod	87	101	992	951

Accident rates in various districts in Kerala are mostly different from each other. In high accident rate group, it is the capital district of Kerala Trivandrum which stand first. There is a huge increase in the death rate from 2009 to 2014 and in the case of injuries it is Ernakulum which stands first. Both Ernakulum and Trivandrum are economically, politically, important places of Kerala. The mobility of people is also more in these places as compared to other districts. The third place is taken by Thrissur. The total accident cases and deaths in them have increased in a great number from 2009 to 2014. Kottayam, Kannur and Pathanamthitta are the three districts where the rate of accident and deaths are in moderate numbers as compared with all the other districts. Between two time periods the number of cases and deaths has not increased marginally. Kottayam and Kannur are big districts with high mobility but even then the accident rate is not so high. Both the death and injuries have not shown much variation. The most positive part of the analysis is that Idukki, Wayanad, Kasargod are the three districts which recorded very low accident rate in both the time points. Idukki and Wayanad are mostly hilly regions and it can be the reason for less mobility. The number of cases, deaths and injuries are in very less numbers. In Idukki in 2009 deaths were 83 and it has just moved on to 87 in 2014. So this shows that accidental cases are very lees in number in the area.

Table 6: Accident cases by different vehicles 2009 and 2014

Type of Vehicle	Cases 2009	Deaths	Cases 2014	Deaths
KSRTC	945	198	1017	195
Private bus	4764	611	3540	462
Four wheelers	7742	718	9169	829
Goods vehicles/heavy vehicles	3200	632	3681	688
Three wheelers	4395	230	4766	343
Two wheelers	10415	882	13167	1343
Others	176	36	942	189

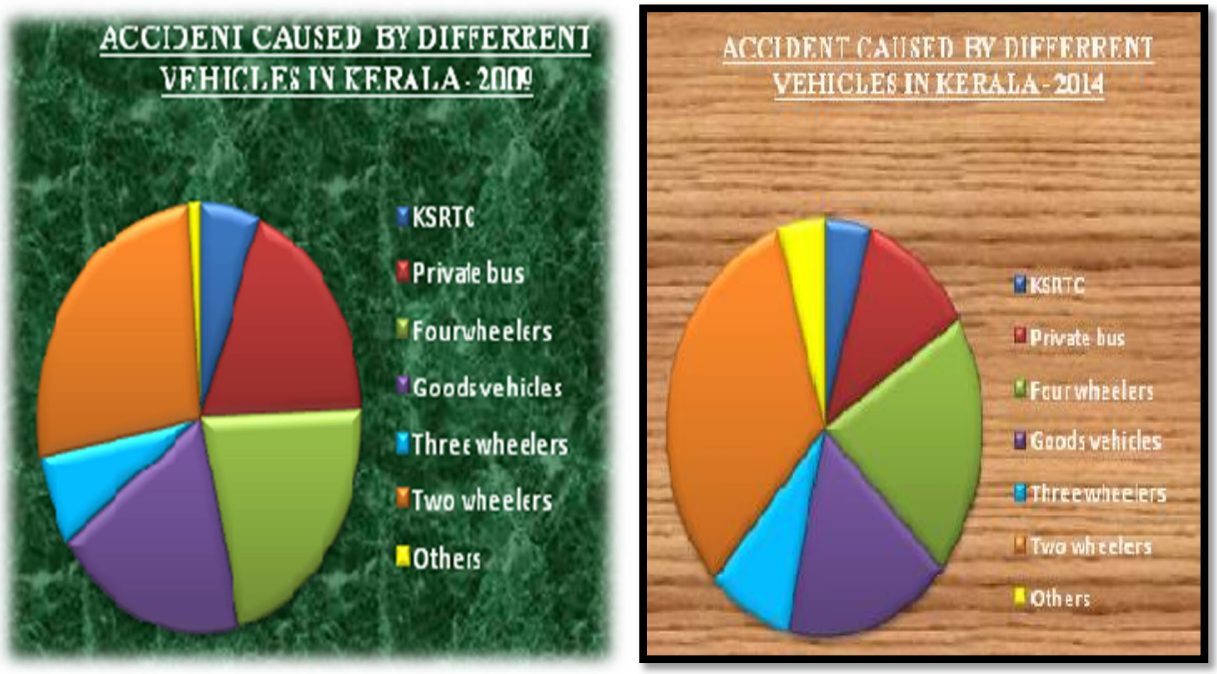


Fig.No.2

A. Accident Prone Zones In Kerala (2012)

The tables given below shows important places where the accident cases are more in number. The division is based on district basis. The statistics is taken from the accident data 2012.

Table 6: Accident Prone Zones in Kerala (2012)

Trivandrum city	Fatal accidents	Non fatal accidents
Papanamcode	7	35
Karamana	3	14
Thiruvallom	7	26
Nemom	4	27
Plamoodu	3	11
Pongumoodu	2	15
Trivandrum rural		
Thonnakal	4	20
Maamom	3	10
Paroorkuzhi	3	14
Aralammood	3	16
Vetikonam	3	8
Kollam		
Polayathod,thata mala	13	99
Anjalammood	5	8
Kottiyam	4	97
Karunagapally	3	19
Pathanamthitta		
Nelimootil padi,adoor	3	14
Alapuzha		
Aroor	13	38
Chantiroor	4	27
Ermaloor	5	40
Ramankari	3	17
Thotapally	4	17
Tazhekara	4	16
Thatarambalam	4	39
Kalavoor,pathirapally	9	47
Nagiyarkulangara/rk jn	9	21
Kalarkod	7	46
Kottayam		
Kanmala	16	36
Idukki		
Thodupuzha-vengaloor	3	14
Ernakulam city		
Idapally	6	87
Kalamaserry	6	42
Vytilla	4	58
Palarivattom	3	45

Goshri palam	4	21
Kakanaad	4	52
Ernakulam rural		
Paravoor jn/thotakatukara	6	43
Muttam	4	29
Vallom-thanipuzha	6	39
Angamally town	6	31
Kolamcherry	4	27
Thrissur		
Puthukad	5	12
Peechi jn	4	14
Kanimangalom	4	8
Chiyaram	3	8
Farm padi,mannuthi	3	5
Palakkad		
Padalodmood,kananoor	24	64
Valayar,kanjikode	20	44
Kalekad,idathara	12	32
Karimba,notamala valav,mannarkad	10	30
Malapuram		
Musiliyarangadi jn,ayikarapadi	10	2
Vattapara valav		4
Idimuzhikal	3	9
Melmuri	3	2
Kozhokode city		
Thondayad jn	6	36
Ramanatukara nisri jn	5	14
Kozhikode rural		
Chengotkaavu,vengam	15	91
Thikodi,ayanikaad	9	22
Tamarasseri-engapuzha	5	27
Wayanad		
Kolgapara	3	5
Kannur		
Mangode	4	4
Kasargode		
Imgoth	4	

The table above shows the most accident prone places in various districts. Trivandrum Ernakulam, Alapuzha, Kollam and Alapuzha are having large number of areas prone to accident, the number of fatal accident and non fatal accidents are in huge number in these places. The following statistics is well projected with the help of interpolation tool in ArcGIS. Spline method is use to depict the fatal and non fatal accident spots of Kerala state.

VI. MAIN BLACK SPOTS AND FACTORS BEHIND THE ACCIDENT

Some of the main black spots of Kerala which have been identified for rectification and finding solutions are given below.

A. Kanamala - Kottayam

Kanamala is situated near Pamba valley in Erumeli panchayath of Kottayam district. This particular place is one of the important black spots of kerala. It is situated in the district of Kottyam. The main reason for the accident in this place is the cambering of roads. Police department have taken many steps for reducing accidents by fixing sign boards 24 hours petroling, speed reduction boards etc. but still accidents are occurring in this place and the reason behind it is the faulty road construction.

B. Vattapara valav- Malapurram

This zone is located in the district of Malappuram in nh 17 and the place is known as Vattapara Valav. Accidents are a daily routine in this place. The main reason behind the accident id high ascent curve and hair pin bends along the road. .because of this reason drivers are not able to see the vehicles coming from opposite direction steep scarp is also one reason. Tanker lorries often go upside down here because of the fluid dynamics involved in the tankers. Unscientific road construction is also one of the major factors behind it.

C. Trivandrum-PMG-Plamoodu

These are the main points from Trivandrum district, the particular places are very much prone to accident, and they are mainly city region. The main reason for accident may be due to the accenting and descanting roads. The road has to be re-constructed to rectify the defect. Traffic police men and the pedestrians are the most affected ones in these points.

D. Myllakadu – Kollam

Myllakadu is a small town in the kollam district. The roads are constructed in unscientific way, the main reason behind the accident cases in this region are the steep roads and the over speed of vehicles from both the ends. It can be resolved only if the road is made more flat and steepness should be reduced to maximum. Speed detection cameras and sign boards are very much necessary along the roads which can provide an idea about the road for the new comers along the route.

E. Idapally toll (Changapuzha) – Ernakulam

Idapally toll is an important junction in the district of Ernakulam, and the accident spot is also located near tool booth, it is the largest toll booth in Ernakulam district. Pedestrians are the most affected individuals in this point. Due to high traffic and pedestrian crossing the road carelessly leads to most of the accident cases. Some important solution to reduce accident cases in this spots is by installing barricades and traffic signals should be maintained by the police department. In the same way construction of subways and over- bridges are also a good remedy for the solution of accident cases in this place.

F. Challingal (Hosdurg taluk) Kasargod

Challingal is located in the Hosdurg taluk of Kasargod district. The main factors causing accident cases in this point is the unscientific road construction. The roads are having steep slopes and bend which leads to the collision of vehicles. The roads have to be re constructed using appropriate road engineering techniques. The number of accident cases reported in this region is high in mark.

G. Alphonsa college (Pala) – Kottayam

Alphonsa college junction is one of the most important road networks in Pala Kottyam district. The number of accident taking place in here is in great numbers. The problem of this junction have been solved by installing rumble strips, which are a road safety feature to give alertness to the drivers of potential danger by causing a tentative vibration and audible rumbling transmitted through the tyres to the interior of the vehicle. This has immensely reduced the number of accident cases in this place.

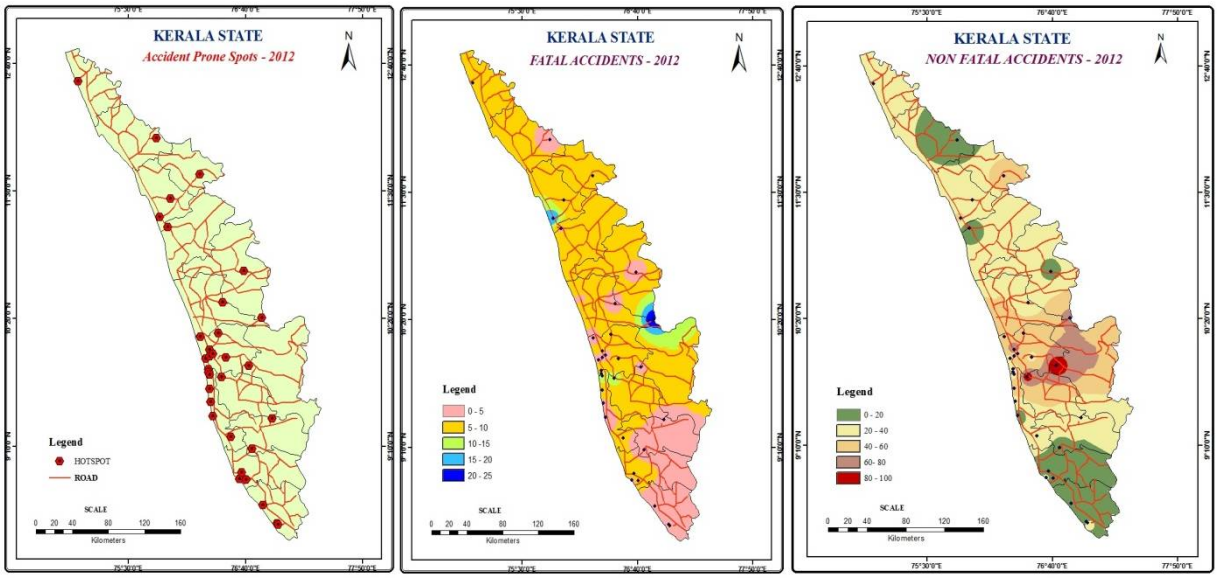


Fig. No.3

V. CONCLUSION

With the rapid development of our national economy, the issue of traffic safety becomes increasingly prominent, and has attracted widespread attention. India has the highest number of road traffic fatalities in the world, with at least 14 people dying on our roads every hour. This growing trend of serious road accidents has created an urgent need to understand the primary factors involved in these crashes and in the resulting severe injuries and fatalities. The most important part to solve this problem is to identify the problems in the first place. For this, it becomes necessary that we understand the accidents taking place in our country, which is explained only by real world accident data mining in traffic accidents, which helps to find the hidden knowledge and rules, has become an important research area in traffic safety. Currently, most of the traffic information analysis is limited to general statistical analysis, which is hard to explore the rules hiding in traffic accident information. Statistical analysis does not have the capability of map displaying and spatial analysis, and hence is not able to find the spatial distribution characteristic and relationship between traffic accidents and road network elements. So more importance should be given on to mapping techniques and road networking analysis which can help to provide a god picture of the present scenario of accidents and the solutions can be drawn out of it with more appropriate technologies.

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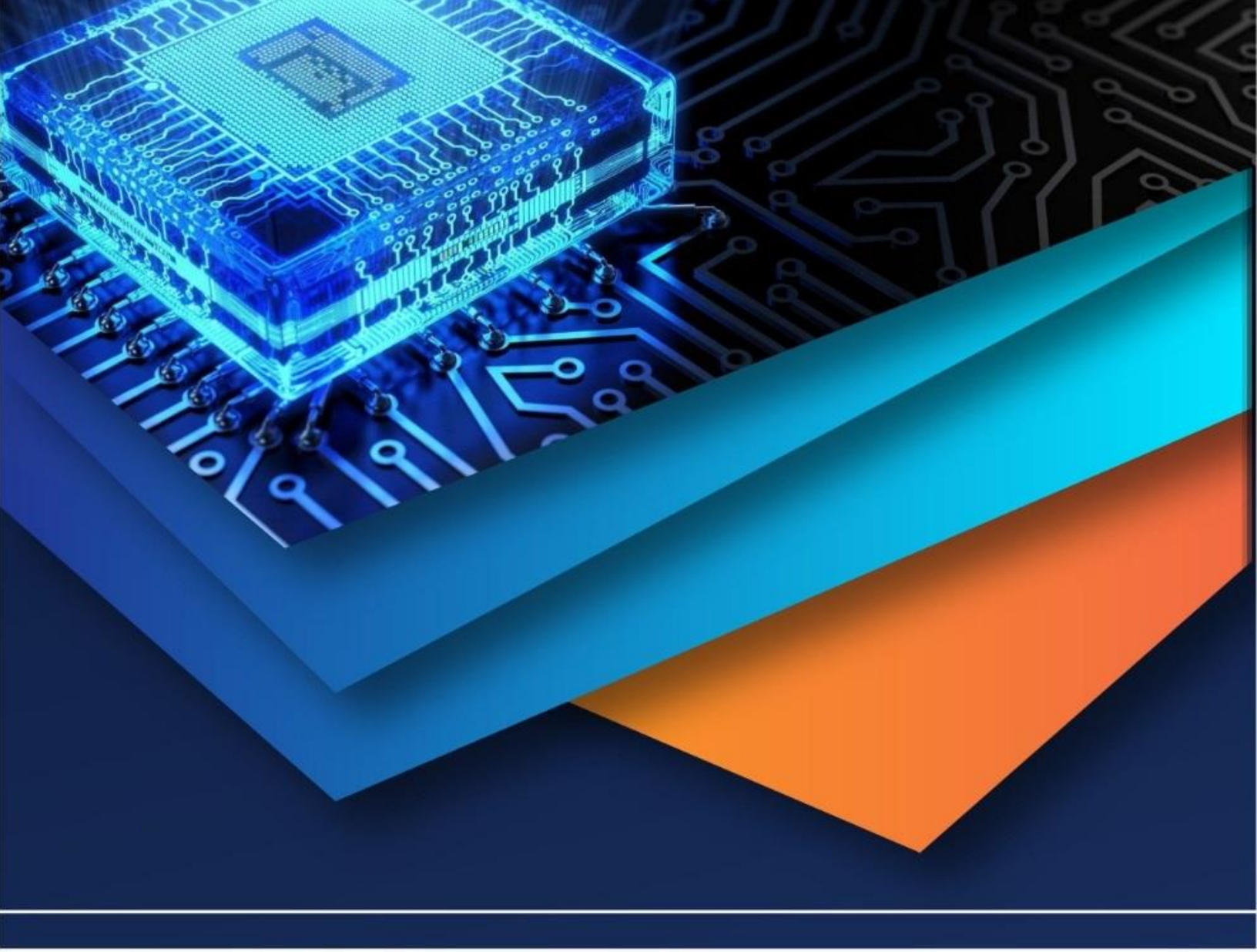

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