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Spatial Analysis Of Road Accident Analysis And Precaution Alert System

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Abstract:

In an emerging nation like India, with advances in transport technology and also a growth in the count of automobiles altogether, road accidents are increasing. Such technological advancement has made traffic risks even greater. Vehicle growth and high population density are among the major causes of traffic hazards. Minimizing traffic possibilities is among the major problems, as the majority of deaths are caused by road accidents globally. There have been plenty of approaches introduced to avoid these road deaths, such as creating specific laws and regulations. Yet most of them did not manage to avoid injuries. This paper offers a clever method for preventing the road accidents for the health of human life. A few of the solutions proposed in this paper is the use of Geo fencing technique as well as spatial road accident analysis using ArcGIS. There are two phases to the process - Accident prone zone precaution that could alert the driver before entering to the prone zone by sending alert notification using Geo-fencing module is to send the warning audible alert to the driver about the accident prone zone when entering before 500 m of the hotspot. Second phase - Accident location is carried out using GPS for spatial analysis by showing hotspots on the map using ArcGIS. On this basis, with the intention of minimising the accident rate, this study provides recommendations for raising awareness amongst people about road and traffic safety.

Keywords: Road accident, Hotspots, Geo-fencing, GPS, Precaution alert, spatial analysis.

I-Introduction

With rapid population growth and continuous progress in the purchasing capacity of people in Tamilnadu, motor vehicle ownership is gradually increasing, as are motor vehicle accidents and fatal accidents, which aggravate the traffic congestion condition in Tamilnadu.***(Qiao & Shang, 2011)***. Road traffic accidents not only lead to fatalities, and to a significant lack of national capital, adversely affecting economic stability ***(Qiao & Shang, 2011)***. A 2016 road accident study conducted by the Division of Transport survey underneath the Department of ministry, Govt. of Indian, has reported as more than 4,00,000 incidents in 2016 resulting is more than 1,50,000 deaths were occurred. The status show at least 1:3.1 people died every day in road accidents [7]. Therefore, better transport services are required which can decrease the number of accidents so as to save lives of countless individuals ***(Wadhahi et al., 2018).*** Tamil Nadu and Uttar Pradesh respectively continued to account for the highest majority of road traffic accidents in 2018. In 2018, the road accident across Tamil Nadu, Indian state, was about 64,000.As a result, the number of road accidents that occur is also increasing, resulting in a huge loss of life due to inadequate emergency services. The major reasons for these road accidents are number of training institutions is less, poorly skilled drivers, poor road maintenance, less warning of drivers, alcohol use while driving, overloading and inadequate government policies in this regard.***(Selvathi et al., 2017)***. To minimize the quantity of fatalities

and losses resulting from road congestion, it is indeed necessary Studying the present situation of road traffic injuries in Tamilnadu, to assess incident quality and to propose appropriate improved measures to counter that are important for improving road safety. The main goals which were targeted are
Sending precaution alert notification about the accident prone zone
Showing spatial information about the accident location and the severity of the accident

The paper is structured as follows is described as follow. Section II will discuss current works, Section III will address methods, and Section IV will discuss future research. Finally, the focus was on Conclusion and References.

Study Area

The district of Thiruvarur is one of 32 districts in the Tamil Nadu state of India. The district takes up 2161 sq. Out of area. Kilometre. (Figure: 1) It is located between the Nagapattinam districts to the east and Thanjavur to the west. Headquarters of the District is town of Thiruvarur. The District seems to have a complicated roadways including a great potential for accidents, which needs a thorough study to free the District from accidents. The research is derived from data of fatalities around Thiruvarur from 2013 to 2017. Originally these accident samples were recorded from the Police Superintendent, Thiruvarur District Police Office.

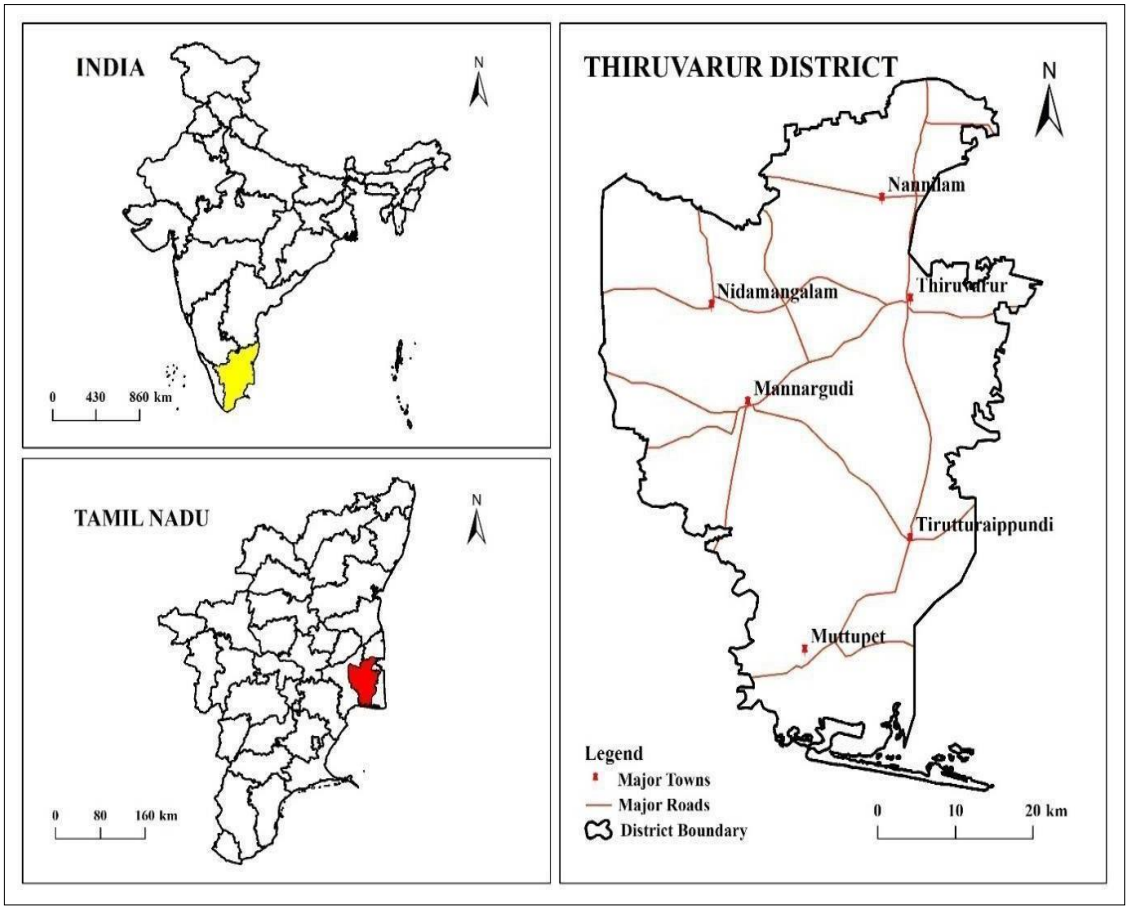

Figure 1: Study area Map

II - Existing work

(Prasannakumar et al., 2011)The market for the automobiles is very strong nowadays. The consequence is hectic traffic so it leads to accidents. For a decade Tamil Nadu recorded the highest road accidents. Several literature articles for the design of the device were reviewed and analysed. Several pitfalls were found in current plays. The density surfaces of the hotspots and kernels were extracted for fatal crashes on the whole and particularly for fatalities during moonsoon and – anti-monsoon periods and fatalities close to academic environment and festival time. The hotspots were calculated for each defined type of an accident using the Getis-Ord Gi* method.

(Kalaivani, 2017) The detection system senses the frequency the device or item is approaching at. The detecting device transmits the range to the transmitter. The operator evaluates the variety chosen for secure driving process. If the variation is about 5 meters then a "CAUTION" post appears on front module. This makes the added carefully the threat going to approach and switch THE distance.

(Selvathi et al., 2017) Proposed an accelerometer-laden system. It will be observing the motion within three axis. Proposed an accelerometer-laden system. It will be observing the motion within three axis. If any sudden shift is observed in any of the axes it is called an occurrence. When a collision is intercepted, the microprocessor passes the data to the driver's mobile device through the use of the Bluetooth. On the rider's smartphone, the android app will deliver a signal to the number already recorded in the system.

(Thangavel et al., 2019) A GPS based software program is created to monitor the user's current position. At first, any blackspot as well as its slow lane are stored database. The forthcoming hot spot data is collected from its repository while traveling the developed mobile application, and warns the blackspot driver by giving a voice warning before 500 m. As soon the vehicle approaches the hotpot, the microcontroller incorporated with the device takes over the control of the accelerometer and minimize the vehicle velocity relevant to the speed limit of the zone.

(Anderson, 2009) Accident data used in the location data system were in the number layout for the incidents inside the blackspot. The information has been defined by another of two factors, the amount of incidents at every zone, or the amount of sample points at each zone. The accident data used in the location data system were in the number layout for the incidents inside the blackspot. The information has been defined by another of two factors, the amount of incidents at every zone, or the amount of sample points at each zone. The accident data used in the hot - spot registry were in the number format for the incidents inside the blackspot. The information has been defined by another one of two parameters, the amount of incidents at each blackspot, or the amount of sample points at each blackspot. This was subject to two multiple data forms (Stats19 and the infrastructural / transport network) being used. Dataset of locations of differing density and thickness and identified border collisions.

III - Methodology Data:

For the present study mainly two types of data were used namely Spatial and Attribute data. Spatial data include place and their appropriate location of accident prone and the administrative and major road network shape file extracted from various downloadable open source portal such as Open street maps, dat.gov.in etc. Attribute data include date of accidents, details of vehicle collision and severity of accident etc. All these data were collected from Department of Superintendent of Police, Thiruvarur.

Database Design

PostgreSQL is used for data storage since it is fully compatible, transparent as well as promotes different programming languages such as C++, PHP, Java, C, and Python. This dataset also promotes geospatial data extensions e.g, PostGIS.

The dataset has been compiled of different tables. Hotspots of the accident and the location of the user. Accident hotspot table was used to store information about accident-prone area spots. User location database has been used to hold knowledge regarding the current position of the vehicle.

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3	4	THIRUVARUR	ADIYAKKAMAN	10.763535	79.684583	FATAL	HIT FROM BA	Lorry	T/W	VR	0101000020E
4	5	THIRUVARUR	ADIYAKKAMAN	10.763303	79.689411	GRIEVOUS IN	OTHERS	T/W	Cyclist	SH	0101000020E
5	6	THIRUVARUR	ADIYAKKAMAN	10.764653	79.680055	FATAL	HIT FROM SI	T/W	Govt.bus	SH	0101000020E
6	7	THIRUVARUR	ADIYAKKAMAN	10.763303	79.691042	FATAL	HIT FROM RE	T/W	ped	OR	0101000020E
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9	10	THIRUVARUR	VALAVAIKKAL	10.759639	79.640931	GRIEVOUS IN	HIT PEDESTR	Lorry	T/W	SH	0101000020E
10	11	THIRUVARUR	VALAVAIKKAL	10.760008	79.741993	GRIEVOUS IN	OTHERS	T/W	T/W	SH	0101000020E
11	12	THIRUVARUR	VALAVAIKKAL	10.759808	79.641542	GRIEVOUS IN	HIT FROM BA	Unknown T/W	ped	SH	0101000020E
12	13	THIRUVARUR	VALAVAIKKAL	10.760113	79.642679	GRIEVOUS IN	OTHERS	Unknown T/W	ped	SH	0101000020E
13	14	THIRUVARUR	VALAVAIKKAL	10.758669	79.634858	GRIEVOUS IN	HIT FROM RE	T/W	Ped	OR	0101000020E
14	15	THIRUVARUR	VALAVAIKKAL	10.760377	79.643656	GRIEVOUS IN	HIT FROM SW	unknown T/W	T/W	SH	0101000020E
15	16	THIRUVARUR	VALAVAIKKAL	10.759491	79.633635	GRIEVOUS IN	HIT FROM SW	Van	lorry	VR	0101000020E
16	17	THIRUVARUR	VALAVAIKKAL	10.762263	79.630663	GRIEVOUS IN	HIT PEDESTR	unknown Tat	T/W	OR	0101000020E
17	18	THIRUVARUR	VIJAYAPURAM	10.761111	79.645381	GRIEVOUS IN	HIT FROM BA	Car	T/W	SH	0101000020E
18	19	THIRUVARUR	PULIVALAM	10.760691	79.644779	GRIEVOUS IN	OTHERS	T/W	ped	OR	0101000020E
19	20	THIRUVARUR	KIDARAMKOND	10.765222	79.663404	GRIEVOUS IN	HIT FROM RE	T/W	ped	SH	0101000020E
20	21	THIRUVARUR	KIDARAMKOND	10.765137	79.664221	GRIEVOUS IN	HIT FROM SW	Van (Eicher	ped	VR	0101000020E
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24	25	THIRUVARUR	VILAMAL ROA	10.773416	79.622779	FATAL	OTHERS	T/W	Cyclist	OR	0101000020E
25	26	THIRUVARUR	VILAMAL ROA	10.773606	79.622607	GRIEVOUS IN	HIT FROM RE	T/W	Self - T/W	OR	0101000020E
26	27	THIRUVARUR	VILAMAL ROA	10.773754	79.622436	GRIEVOUS IN	HIT FROM SI	Mini Bus	lorry	VR	0101000020E
27	28	THIRUVARUR	VILAMAL ROA	10.775672	79.620118	GRIEVOUS IN	HIT PEDESTR	Tata Ace	T/W	SH	0101000020E
28	29	THIRUVARUR	KTR NAGAR	10.768526	79.626684	GRIEVOUS IN	HIT FROM SI	Lorry	Cyclist	SH	0101000020E
29	30	THIRUVARUR	KTR NAGAR	10.768884	79.626405	GRIEVOUS IN	HIT FROM RE	T/W	T/W	VR	0101000020E
30	31	THIRUVARUR	KTR NAGAR	10.766186	79.631336	GRIEVOUS IN	HIT PEDESTR	Lorry	Govt.bus	VR	0101000020E

Figure: 2 Accident hotspots location database using PostgreSQL.

Methodology:

Framing the methodology is very essential before and during the task related to any field, and moreover a conceptual diagram gives a framework for future processes regarding the study. The following *Fig: 2* concisely explains the various methods applied in order to arrive at the intended results. The spatial analysis in the methodology can be divided into two segments viz. Web Interface development and mapping in ArcGIS.

The first segment includes location based services embedded web interface development for

analysis of road accidents taken place on five year data 2013-2018 in the study area. The map use a Pre- hypertext processor (php) file that acts as the interface between the database and the map. In the present study inputs were collected for both spatial and non-spatial / attribute data. It's a bi-folded objectives one is based on spatial analysis of severity of the road accident map which shows the information about the severity from the database using ArcGIS. And another one is alert system that is gives out alert to the person who enters into the influential buffer area of accident prone zone. The alert system reminds all users and make them aware of the geography even before they enter the space and thereby reduce the accidents indirectly

A) Geo-fencing Module

The model of geo-fencing is the basic model, and the main working one. The location can be searched in this Geo-Fencing model using GPS (Global Positioning System). With this model, you can simply take the user's position name and locate that location on the map and click on save location to save that location and set a circle around that location using the GPS system's longitudes and longitude and when that location reaches, it will automatically beep the user's alarm tone and send the SMS to the mobile phone. In this we have to give the source and destination of our place. Then the route of the given location will be highlighted on the map and it also show the accidents spots with red colour dots shown in Fig: 3. Then we start the journey no need to worry about the zone because the application will send you the audio and text message Fig: 4. With the help of this application we go even unknown place with the precaution.

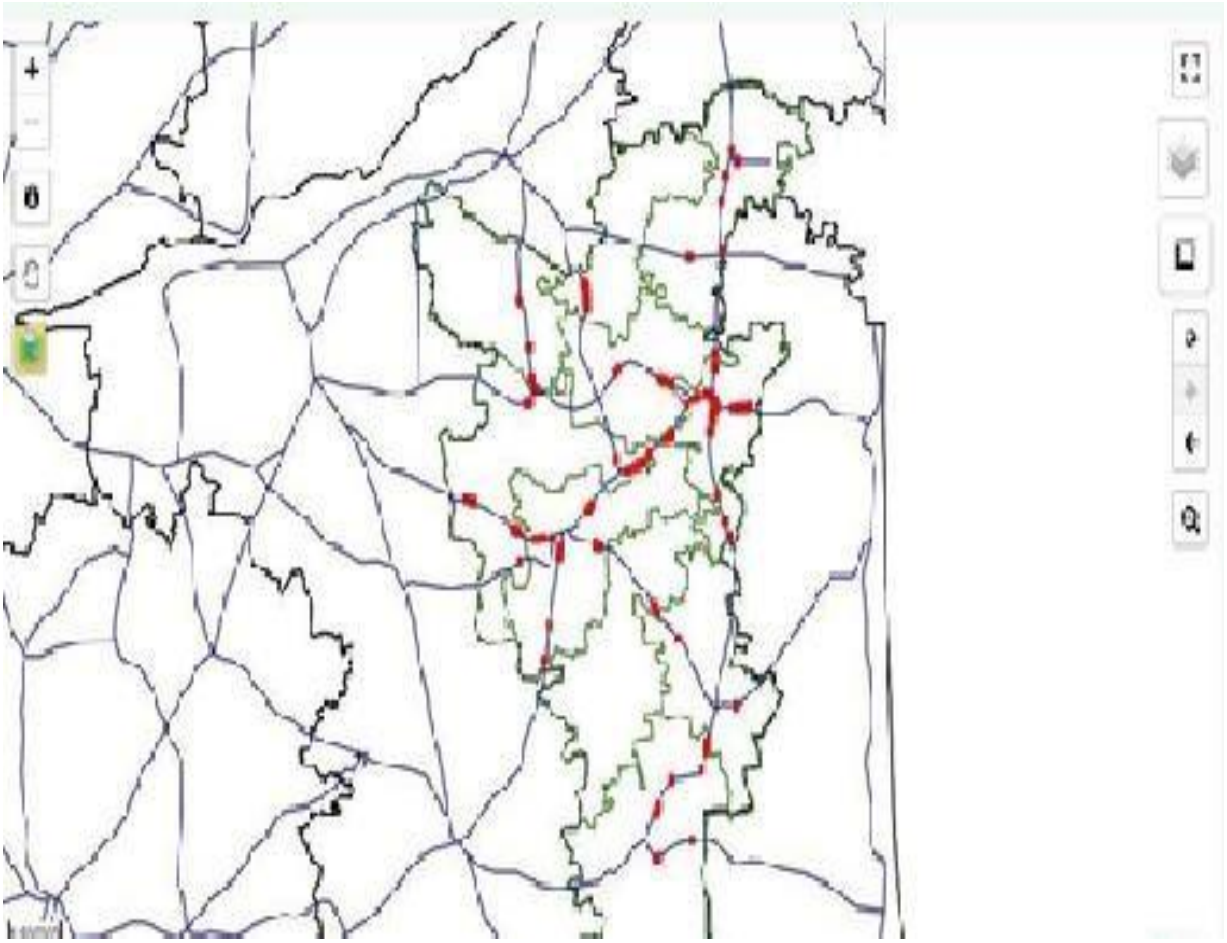

Figure: 3 Web interface with road map and accident hotspots of Thiruvarur district

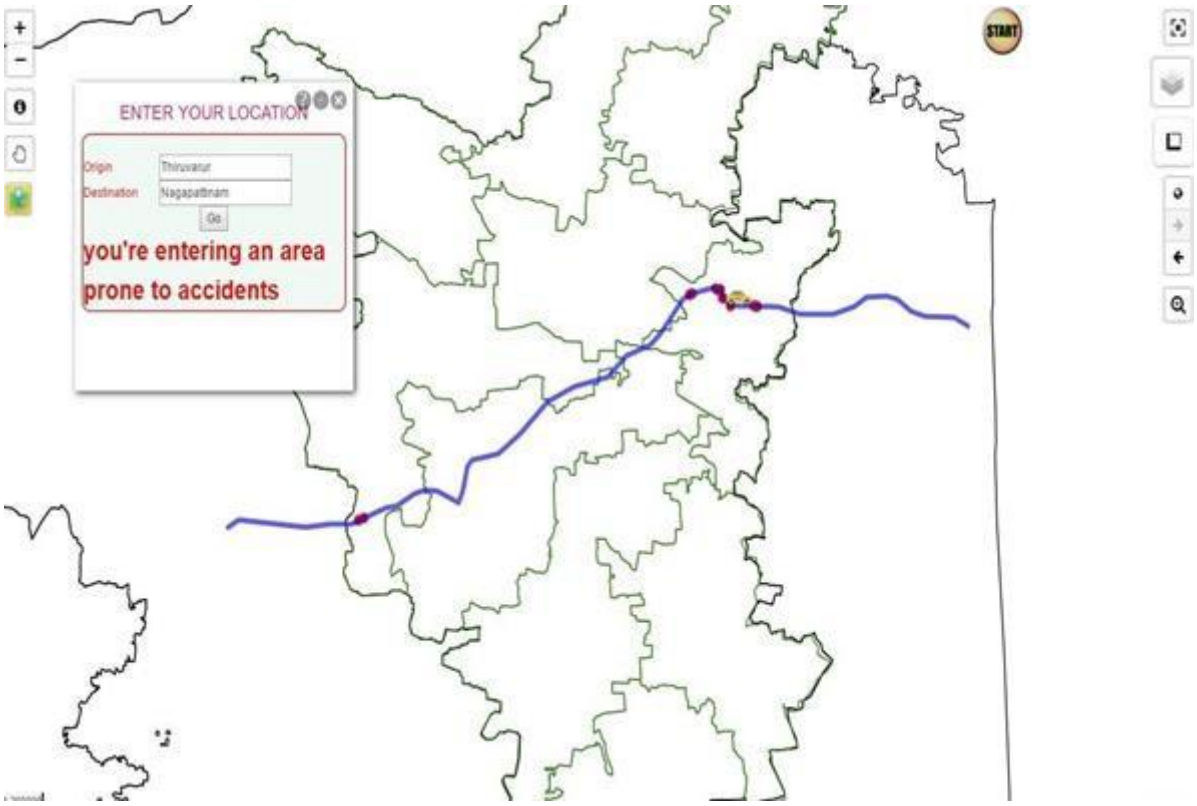

Figure: 4 sending precaution alert to the driver when entering to the accident prone zone

B) Spatial analysis module using ArcGIS

The analysis module is process with the database. Using query we retrieve the data on the web interface. This module demonstrates spatial analysis about severity of the accident and location if the hotspot, using this module we can know the more details about historic accidents.

i) Accident locations

The Accidents happened in Thiruvarur District in the year 2013-2018 over five years with their absolute locations are shown in the *Fig: 5* with the base layer as the blocks and major roads of Thiruvarur District. The clustered points in the North central stretch of the study area clearly elaborates that frequency of accidents have took place in Thiruvarur, Manargudi, Needamangalam blocks which have NH 67, SH 202, 63 and 65 passing along them, evidently speak about the various reasons of high frequency of accidents namely, more traffic as compared to other blocks due to close proximity of the biggest town in Thiruvarur District, passing National highway connecting other major cities if the state bringing in more traffic, heavy vehicles, and riding at a higher speed.

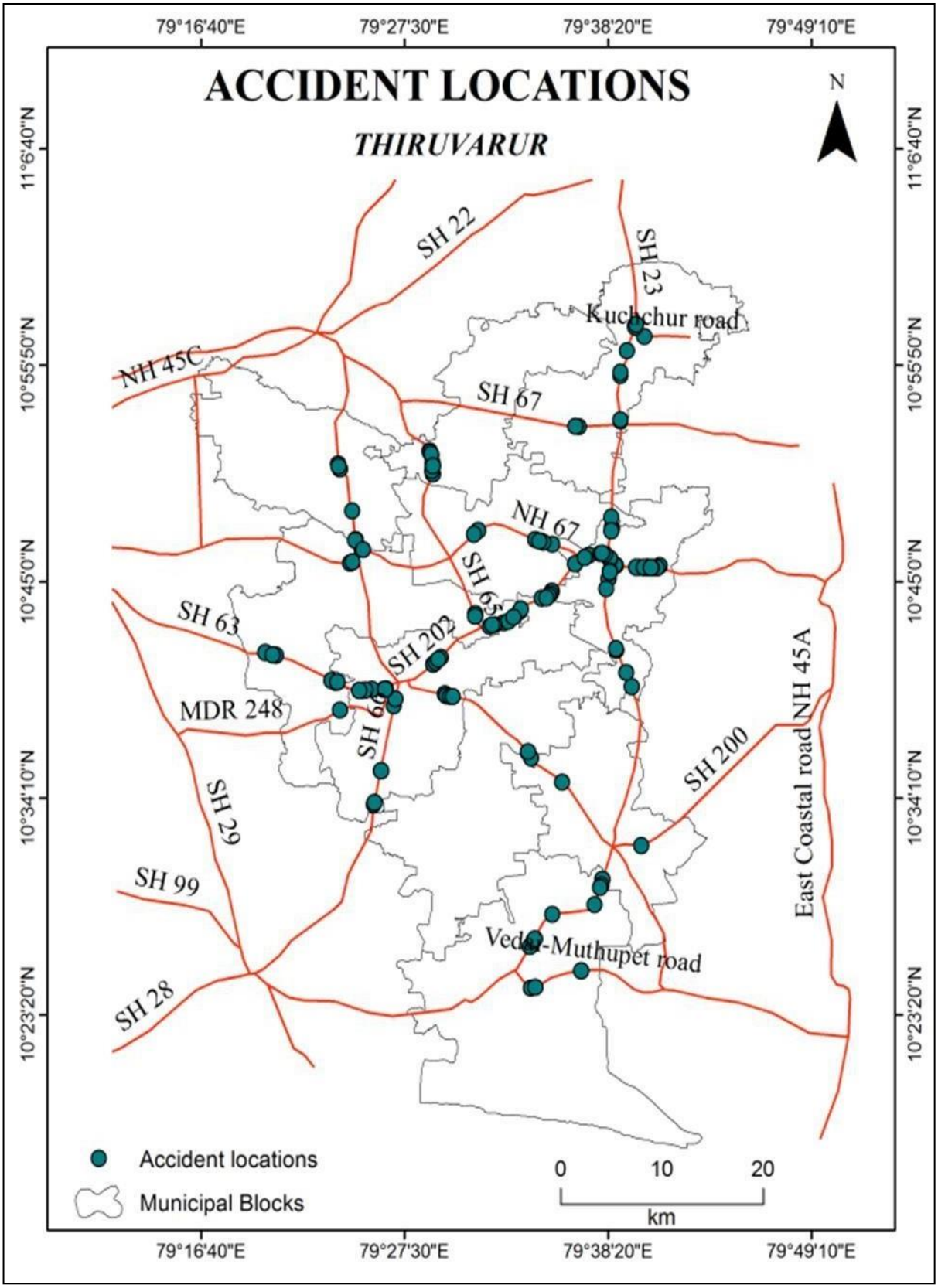

Figure: 5 spatial analysis of Fatal Accident hotspots in Thiruvarur_2013-2017

ii) Severity of Accidents

The severity of vehicular accidents based on their total frequency in accordance to the roads and blocks in the district. The roads and the blocks were classified as per the number of accidents occurred in the particular blocks and on or near to the roads. The Block wise severity, as shown in *Fig: 6* classifies Thiruvarur block with Very High severity as the frequency of accidents occurred there in the last year is 62 out of the 155 total locations collected, that is an outnumber to all the other blocks because, there are major highways (National and State) passing through, making it a connecting node to other major cities of the state. It serves as a centre place in all terms for all the blocks of Thiruvarur city, therefore the transport networks are nucleated (According to Christaller's Centre Place Theory) there and temporary migration of people by vehicles from other places for major activities such as trade, employment, finance etc. The other blocks under High severity are Manargudi, Needamangalam from which the two major state highways and one national highway passes by making them secondary nodes of the centre place. The other blocks in the periphery of these major towns mentioned above comes under Very Low to Low severity zones due to less road connectivity or presence of lesser important towns and villages where people mostly travel back home making them the roads passing from there less severe to accidents and traffic. Another important thing to note is that the south eastern part of the study area though classified as less severe the number of accidents there show an increasing trend due to the close proximity East-Coastal road NH 45A towards the eastern border of the study area.

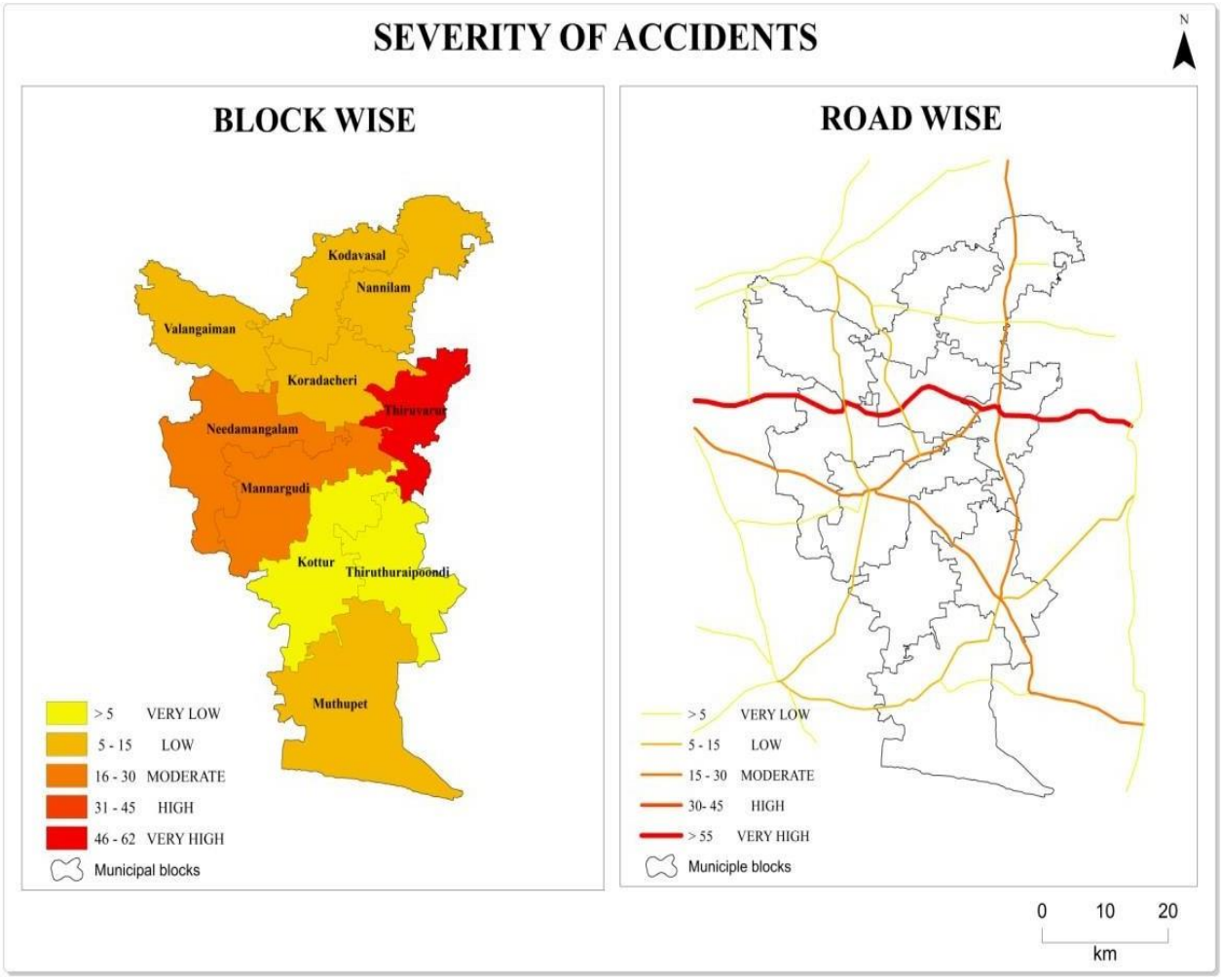

Figure: 6 spatial analysis for Block and Road wise Severity in Thiruvarur District_2013-2017

IV - Summary and Conclusion:

Basically, the web application is used for User Interface (UI), as an implication of the advanced technology in this study, web application utilizes the Location Based Services (LBS) to users. Road accidents in today's world are more rampant, through this study LBS is useful to identify the number of accidents happened in a particular location. Moreover, the emerging technology GPS is widely used in India for a decade. So the, study concludes that the real-time updates based on LBS is significant in real life situation. Apart from that a new interactive Location based service is developed using php and PostgreSQL which is embedded with geospatial mapping techniques which shows the accident prone zone on map and sending an audible alert notification system to warn the drivers about the accident prone zones before and during the journey using Geo-fencing technique. An alert system was developed after recognising the most severe road stretch with spatial analysis in ArcGIS. The studies like these embedded with real time solutions should be widespread to the common people through open source technology by the concerned governmental authorities.

Future Work:

The further recommendations regarding this phenomenon based on the findings of this study are:

1. Improvising the present system with new advanced technologies.
2. To increase the surveying methods regarding the peoples thought of what are the possibilities of an accident situation for prior caution measures.
3. Increasing the number of alert devices on the roads between frequent distances.

V - REFERENCE:

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