

Review paper on Road Accident analysis using Arc GIS and Road safety Audit

Fazil Fayaz¹, Ashraf Hussain², Bharath Reddy E³, Abdullah Raza⁴

¹²³⁴UG Scholar, Department of Civil Engineering, Dayananda Sagar College of Engineering, Bangalore, Karnataka, India

Abstract - Accident analysis using ArcGIS is a powerful tool for understanding the factors that contribute to traffic accidents and for identifying strategies for improving traffic safety. ArcGIS, a geographic information system (GIS) software developed by Esri, allows for the integration and analysis of a wide range of spatial and non-spatial data, including information on road infrastructure, traffic volume, land use, and accident locations and characteristics. This paper discusses the use of ArcGIS in accident analysis, including the types of data that can be analyzed, the methods and techniques that have been developed for analyzing and visualizing this data, and the challenges and limitations of using ArcGIS for accident analysis. The review also suggests directions for future research in this area. Overall, the use of ArcGIS in accident analysis has the potential to significantly improve our understanding of traffic accidents and to support the development of effective strategies for improving traffic safety.

Road safety auditing is a systematic process for identifying and evaluating potential safety problems on roads and highways, and for proposing solutions to these problems. It involves a thorough examination of the physical and operational characteristics of a road or highway, as well as the behaviors of road users, in order to identify and prioritize safety concerns. This paper discusses the various methods and techniques that are used in the process. The paper also examines the role of road safety auditing in the broader context of road safety management, including the ways in which it can be integrated with other safety improvement strategies such as engineering, education, and enforcement. The review concludes by discussing the potential challenges and limitations of road safety auditing, and suggesting directions for future research in this area. Overall, road safety auditing is an important tool for improving the safety of roads and highways and for reducing the incidence of traffic accidents.

Key Words: Arc GIS, Statical analysis, Safety auditing, Road accidents.

1.INTRODUCTION

Road accident analysis using ArcGIS involves using geographic information system (GIS) technology to analyze and understand patterns and trends in road accidents. This can be done at various scales, ranging from the analysis of accidents at a specific intersection or stretch of road, to the analysis of accidents within a

city or region. One common method for conducting road accident analysis using ArcGIS is to create a map of the study area, and then plot the locations of road accidents on the map. This can be done using data from police reports or other sources, and may involve the use of spatial data such as road networks, land use, and population data to provide context for the analysis. Once the data has been mapped, various analysis tools and techniques can be used to identify patterns and trends in the data. For example, one might use spatial analysis tools to identify areas with high rates of accidents, or use statistical analysis to identify relationships between accident rates and factors such as speed limits, traffic volume, or road design. Other techniques that might be used in road accident analysis using ArcGIS include network analysis to identify the most efficient routes for emergency responders, or the use of 3D visualization tools to better understand the layout and features of the road network. Overall, the goal of road accident analysis using ArcGIS is to identify the underlying causes of accidents and to develop strategies for improving road safety. This may involve implementing engineering solutions such as redesigning intersections or installing traffic calming measures, or implementing educational and enforcement programs to encourage safe driving behavior.

Road safety audits are systematic evaluations of roadways and intersections to identify potential safety problems and recommend solutions. The goal of a road safety audit is to reduce the number and severity of crashes on a roadway by identifying and addressing any hazards or deficiencies in the road design, operation, or maintenance. Road safety audits can be conducted at any stage of the roadway design process, from the initial planning and concept development stages to the construction and maintenance phases. They can be conducted on new or existing roadways and may focus on a specific type of roadway, such as a highway, local street, or intersection. The process of conducting a road safety audit typically involves a team of professionals with expertise in engineering, traffic

operations, and road safety. The team will review the roadway and its surrounding environment, assess the potential risks and hazards, and identify opportunities for improvement. This may involve analyzing crash data, observing traffic and roadway conditions, and reviewing design plans and documents. The findings of a road safety audit are typically documented in a report, which includes a summary of the audit process, a description of the roadway and its surrounding environment, a list of identified safety issues and recommended solutions, and a cost estimate for implementing the recommended improvements. The report may also include recommendations for further study or analysis. Overall, road safety audits are an important tool for improving roadway safety and reducing the number of crashes on our roads.

2. LITERATURE REVIEW

The extensive literature review was carried out by referring standard journals, reference books and conference proceedings. The major work carried out by the different researchers is summarized below.

1). Professor Leni Stephen et al analysis on black spot identification and prioritization of the accident spot using arc GIS application with the detailed survey of road geometric parameters, like formation width, median shoulder, surface type, surface condition, edge obstruction, load signs, drainage facilities and visibility on the study area of sit 1 for stage of 14 km with height traffic density

The Analysis result with prioritized zooming of accident-prone areas with (black spot mapping) and recommended suggestion for all identified black spots.

2). Ghulam ali shajabak hsh, et al Using Mashad city (Iran) ask case study area. Carried combination of Jio information technology and spatial statistical analysis to being out their influence on road accident. The aim of study was to examine an enduring analysis. Which includes. 1 Karnal density #2, nearest neighbor distance #3K function analysis with. #4ARC GIS. To get better understanding of accident in complex urban networks. The final result obtained from the papers of. Papers are. Regarding the pattern of accident with examination of cows of fatalities. These studies resulted in prioritizing. The area of high accident rate according to injuries and fatalities.

3) V.prasanna kumar et el evaluated South Indian. City. Thiruvanthapurm with inadequate development of land. Transport leading to congestion and accident.

Assessment part of spatial clustering accident and hotspot was carried out. Following ARC GIS. Moran eye method and GETIS. OrdGI and kernel density for result of accident. The study focuses on the accident during monsoon and Non monsoon. Time and accident near of region and education institution. The studies conclude with different accident kind in terms of temporal and spatial aspects. The result can be used efficiently for successful management of traffic and reduction of accident.

4). Ishan crada, et al Made study in which identical issue is being. Created to solve the approach suggested. In this research, attempts to make use of data found in accident records by removing the factual and preventative information. A case study of Pilam town Is conducted to evaluate the variability of variables and analytical techniques in non-urban settings to consolidate the data records available at Hotspot and police station Two of the areas source of data collecting It was picked as a good alternative for the aim of gathering data over police station To choose best approach of analyzing the collected data and mapping of accident Various statistical and geographical analysis techniques including Separation. Autocorrelation And kernel density examination is being examined One tool used is GIS to achieve better road safety.

5). Mohammad Bahar Ali Rabbani. ET AL Made studies which uses spatial analysis. And statistical methods to examine the spatial destruction of the local traffic accident. This research study goal is to examine traffic collision that take place in Peshawar. Moyatabad neighborhood. The study main goal is to use sophisticatedly statistical techniques to find accident hotspot in Nistal area. Using a ARCGIS. 10.2. A system of analyzing the spatial pattern. Off traffic accident and locating hotspot. Was created in order to identify hotspot clustering of accident spots in ArcGIS. This study used the NHA special color studying algorithm in crime stat. Interpolation. Ki. A geostatistical method known as cringing method was also used. To access the result computed, the study concludes that the accident at these hotspots is caused by illegal parking violation or traffic rules. done without deteriorating etc.

6). Ibrahim Yilmaz ET AL in their research the tabular data was Geo referred to highway in a system that converted that text data to tabular format the highway within the administrative boundaries of Afyonkarahiar we are investigated and defined using two different kernel density analysis method repeatability analysis the accident vision at the is hotspot where then investigated the method reflects where the intersection

crossroad etc. are really problematic many studies so far have only introduced GIS as visualization.

7). Mazhar Sayed ET AL in this paper explained the application of geographical information system GIS and prepared traffic plan they are tempted to supply the Traffic Safety audit process by investigation GIS based software gram++ a road of about 3 kilometer across national route 17 Panvel and lidapur we are used in the study digitization of all the feature of road segment has been performed database created then which will help rotating to analyze all the layered segment in proper way.

8). Kohinoor Kar ET AL have been involved with several RSA the study is done on performance throughout Arizona this document describes Arizona RSA the program includes issue and recommendation identified by two people having conducted dozens of audits so far RAS's success rate is better in prevention of accident in many places of the US and in the rest of the world.

9). Sanjay Kumar Singh ET AL carried research on road traffic accident in India issue and challenges by analysis at national level and state level resulting in road accident deadly and injuries further bifurcating the data into age and sex wise distribution and month and time wise distribution and causes road accident data shows that male fatalities are higher than female accidents are higher in May and June and December and January the most accident occurred during 9:00 AM to 9:00 PM mostly of causes for accidents are driver faults in accounting 78% although solution for road safety differ from state to state that have very high rate of motorization some basic principle would remain same example good road design traffic management improved vehicle standard speed control use of seatbelts and helmets and info or alcohol limits.

10). Yannis George and team investigating on road accident severity per vehicle type for that reason a data set consisting of 5931 six recorded accidents increase was analyzed and mathematical models were developed by applying normal pretty Gration in total 15 statical model were developed one for each vehicle type and for each accident separately the result of the study can be proved useful for enhancing road safety further research could focus on examining additional parameters such as Road geometric traffic area and region in Greece could be explored.

11). Tessa Anderson used kernel density estimation of determining road accident hotspots that is dependent on intended outcome. If the intention is to use only

road accident data for the analysis of hotspots, then other methods be more suitable than kernel density since, there are lot of tools in arc GIS.

12). MD Ali Aghajani ET AL did research on Number of accidents in province with mountainous climate and rainfalls of more than 500mm is high. Hotspot analysis shows that these regions have cluster concentration but with lower weights.

13). Tummala Bhart Kumar,etal carried out road safety audit for improvement off road safety for the study area of NH 65 . The objectives were identification of imperfection with the design, identification of accident-prone areas on the highway. And study carried for roadway geometric impact on highway. The study the study resulted in suggesting the improvement to the to be made in Rd geometric, signification and marking with necessary lighting provision for night travel.

14) Devang G Patel, ET AL carried out ROAD safety audit on state highway 83 and state highway 188 one of the major highways in the state of Gujarat connecting to NH 8 with high traffic frequency. The objective was to study land use pattern with causes of accident and major accident-prone areas with all the data collected and analysis they have concluded the major accident occurred due to there are drivers' error with other possible like poor geometry, high traffic density, environmental factor etc they have suggested some remedial measures to contract these accidents like proper licensing system improvement of light etc.

15)Alvydas Pi Kunas, ET AL carried out an economical evaluation of road safety measures with proper safety and cost benefits in lithunia. They carried. It out by traffic planning. Process which includes activities for effective. Transportation service with economic, social, and environmental factors. Traffic planning includes. Structural plan. Transportation plan., area plan., traffic management. They also did the road safety audit by examination of existing road feature. In different stages and explained its benefit. The main aim was in general Improving roads safety for Lithuania? Which did not have any road safety auditing system.

16). Yuha huvarinem, ET AL Made demonstration how adhering to automotive road design and construction regulation does not ensure Traffic Safety, the weakest element of transportation system. A person is highlighted into context. Of increasing motorization. Psychological strain and accidental hazards. The conclusion led to adopting extra technology. Capable of reducing accident risk. Stipulated by human. Where

Traffic Safety Audit play a primary role in improving safety.

17). Hugo Pietrantonio ET AL this article describes the current position on the use of road safety and propose new method of studies for a detailed evaluation of some of the characteristic that may defect them key finding of case studies include field observation teamwork use of unexperienced persons for field observation study to emphasize the need for procedures /criteria for RSA.

18). Awcandur Novikov and team research on approach to reduce the number of accidents caused by drivers during analysis group of drivers are categorized into two groups each from 30 to 40 years and driving experience over 15 years these drivers mainly get into RTA due to their own fault speeding failures to observe priority levels violation of overtaking and maneuvering rule as well as drinking driving further researches recommend to improve the level of training and propose method of drivers testing all these measures are aimed to improving road safety traffic.

CONCLUSIONS

After reviewing several papers on accident analysis using Arc GIS and road safety auditing following conclusions have been made

- [1] By mapping accidents and analyzing the data, it may be possible to identify areas where accidents are more likely to occur (hot spots). This information can be used to target safety improvements and interventions in these areas.
- [2] Based on the analysis of accident data, it may be possible to identify interventions that could reduce the likelihood of accidents occurring. This could include things like improving infrastructure, implementing traffic calming measures, or educating the public about safe driving practices.
- [3] By analyzing current trends and risk factors, it may be possible to make projections about the likelihood of accidents occurring in the future. This information can be used to plan for and mitigate potential accidents.
- [4] The audit process should identify any safety issues present on the road or roadway network. These could include issues with the physical infrastructure (e.g. narrow lanes, poor visibility), road design (e.g. lack of separation between different

types of road users), or the operation of the road (e.g. high speeds, aggressive driving).

- [5] The audit should provide recommendations for addressing identified safety issues. These could include physical changes to the road or infrastructure, changes to road design, or the implementation of education and enforcement programs.
- [6] The audit should consider the costs and benefits of implementing different recommendations for improvement. This can help prioritize recommendations and ensure that resources are used effectively.

REFERENCES

- [1]"Identification and analysis of accident black spots using GIS" Mar 2013" International research journal of Engineering and technology "-Leni Stephen, K.S.Sreelakshmi,Vishnu N.B
- [2]"GIS-Based spatial analysis of urban traffic accidents: Case study in Mashhad", IranMay 2017," Journal of traffic and transportation Engineering"-Gholam Ali Shafabakhsh,Afshin Famili, Md Sadegh Bahadori
- [3]"Spatio-Temporal Clustering of road accidents: GIS based analysis and assessment"July 2011"International conference: spatial thinking and geographic information science"-V. PrasannaKumar,H. Vijith,R. Charutha
- [4]"Accident mapping and analysis using geographical information system"Oct 2011"International Journal of earth science and engineering"-Nilesh Deshpande, Ishan chanda, Srinivas S. Arkatkar
- [5]"Analysis of vehicle accidents using spatio-temporal tools in ArcGIS: A case study of Hayatabad, Peshawar"Dec 2019"International Journal of engineering works"-Muhammad Babar Ali Rabbani
- [6]"Geographical information system aided traffic accident analysis system case study: city of Afyonkarahisar"May 2007"Accident analysis and prevention 40 (2008)"-Saffet Erdogan, Ibrahim Yilmaz,Tamer Baybura
- [7]"GIS based road safety audit"Oct 2013"International Journal of science engineering and research(IJSER)"-Mazhar Sayed, Sumedh Mhaske

[8]“Road safety audit: Findings from Successful Applications in Arizona ”2007” Transportation Research Record 2182”-Kohinoor Kar and Michael R. Blankenship

SPbGASU Organization and safety of traffic in large cities” “Avcandur Novikova, Anastasia Shevtsovab, Victoria Vasilievaa”

[9]”Road traffic accident issues and challenges” July 2016” World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016” “Sanjay Kumar Singh”

[10]“Investigation of road accident severity per vehicle type” July 2016 “World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016” “Yannis George, Theofilatos Athanasio, Pispiringos George”

[11]“Comparison of spatial methods for measuring road accident ‘hotspots’: a case study of London”2006” Journal of maps, 2006, 55-63”-Tessa Anderson

[12]“Applying GIS to identify the spatial and temporal patterns of road accidents using spatial statistics”July 2016”World conference on transport research – 2016 Shanghai “-MD Ali Aghajani,Reza Shahni, Dezfoulan

[13]“Road safety audit: a case study on an NH-65”2018” International Journal of engineering and technology”-Tummala Bharat Kumar, Chukkapalli Jeswanth Chowdary

[14]“Road safety audit of selected stretch from Umreth junction to Vasad junction”May 2013”International Journal of Science and Modern Engineering”-Devang G. Patel,F.S Umrigar,C.B Mishra.

[15]“Road safety audit- possibility to avoid a dangerous road section”June 2005”Transport-2005 VOL XX, No5, 181-185”-Alvydas Pikunas and Vidmantas Pumputis

[16]“Road safety audit”Sep 2016”12th International Conference “organization and Traffic Safety management in large cities “”-Yuha Huvarinen

[17]“Evaluating road safety audit procedure: some questions and a new methods of study” Sep 2015” Transportation planning and technology, 2015”-Hugo pietrantonion , Lili L Bornsztein

[18]“Development of approach to reduce number of accidents caused by drivers” Oct 2020 “XIV International Conference 2020