Accident Location Identification and Mapping using QGIS: Blackspots in Kerala

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Abstract

This report focuses on using QGIS for accident location identification and mapping in Kerala, India. It highlights the importance of blackspot identification, outlines the objectives, methodology (including k-means clustering based on accident severity and fatalities), and provides recommendations for improving road safety in identified blackspots.

1 Introduction

Accidents on roads can have severe consequences, including loss of life and property damage. Identifying accident-prone areas, commonly referred to as blackspots, is crucial for implementing effective preventive measures. This report focuses on utilizing QGIS (Quantum Geographic Information System) for accident location identification and mapping in the state of Kerala, India.

1.1 Importance of Blackspot Identification

Accurate identification of blackspots aids in analyzing the causes and patterns of accidents, enabling authorities to implement targeted interventions and reduce road fatalities. By mapping accident-prone areas, traffic management strategies can be devised to enhance road safety.

1.2 Objectives

The main objectives of this study are:

- To identify blackspots in Kerala using a cleaned dataset.
- To cluster the accident data based on relevant factors such as accident severity index, number of fatalities, and the sum of fatal & grievous injury crashes provided in the dataset.
- To map and visualize blackspots using QGIS.
- To analyze the characteristics of the identified map containing blackspot clusters and propose targeted recommendations for improving road safety in those areas.

2 Methodology

2.1 Data Collection

Accident data from the past few years is a valuable resource for identifying blackspots. Collecting accurate and comprehensive accident data, including the location, time, and severity of accidents, is essential for a reliable analysis. The data was obtained from the Kerala state government official site, which included the location of the blackspots and other factors like accident severity index, number of fatalities, and the sum of fatal and grievous injury crashes, etc.

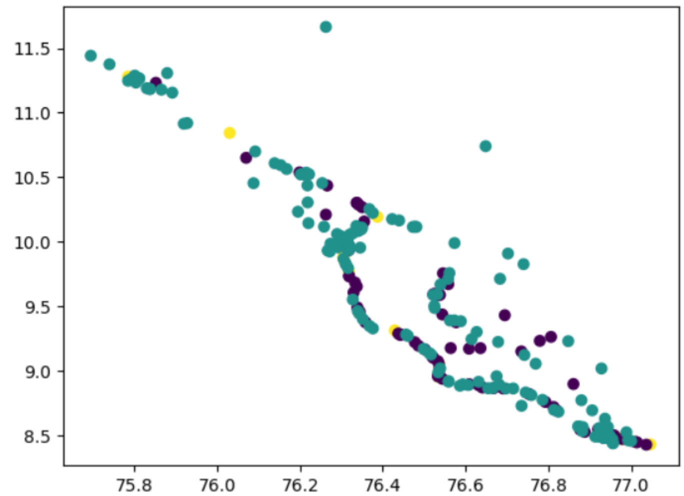

Figure 1: Clustering on the basis of above mentioned parameters

2.2 Preparing the Data for Analysis

Once the accident data is collected, it needs to be cleaned and processed to remove any inconsistencies or errors. The data should be standardized to ensure compatibility with QGIS. We cleaned the data and added the latitudes and longitudes of the exact blackspot locations and the nearest hospitals to them. Attributes like exact latitude and longitude coordinates, accident severity, and other factors were properly formatted.

2.3 Clustering Blackspots using k-means

To identify clusters of blackspots based on accident severity index, the number of fatalities, and the sum of fatal & grievous injury crashes shown in (Figure 1) , we employed the unsupervised machine learning technique known as k-means clustering. This algorithm groups similar data points into clusters, allowing us to identify distinct patterns and clusters of accident blackspots.

2.4 Mapping Blackspots using QGIS

QGIS is a powerful open-source GIS software that provides various tools for analyzing and visualizing spatial data. By importing the cleaned and clustered data into QGIS, we can map the identified blackspots based on the accident clusters.

2.5 Visualizing Blackspots

Using QGIS, blackspots can be visually represented on a map. By assigning different symbols or colors to accident locations based on severity or frequency, the resulting map provides a clear representation of the heat map of blackspots and the nearest hospitals to the them (Figure 2) and final clustered blackspots in Kerala (Figure 3). This visual output aids in understanding the spatial distribution of accidents and helps in decision-making and future use.

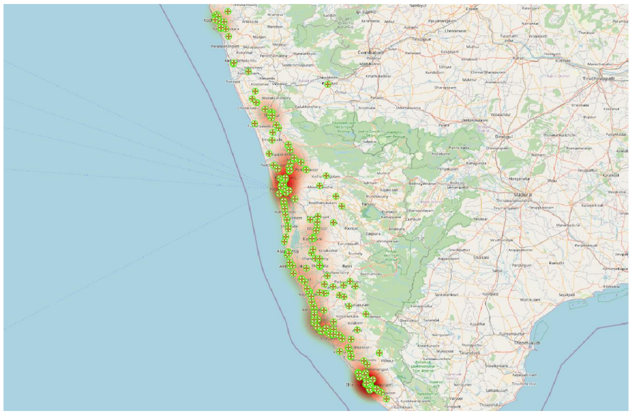

Figure 2: Blackspot heatmap with nearest hospitals

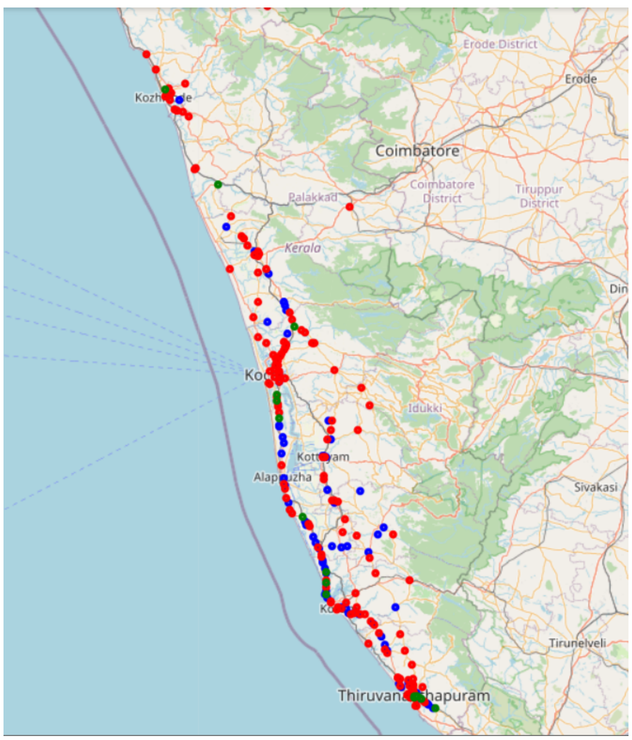

Figure 3: Final Clustered blackspots Map

3 Analysis and Findings

3.1 Identification of Blackspots

The analysis of accident data using QGIS and k-means clustering revealed several clusters of blackspots in Kerala. These clusters were identified based on the accident severity index, the number of fatalities, and the sum of fatal & grievous injury crashes. Mapping the clusters provides valuable insights into the areas that require immediate attention for road safety improvements. (We concluded that the optimum number of clusters would be 3 using the elbow curve method in machine learning) - shown in Figure 7 in Appendix

3.2 Characteristics of Blackspots

Further analysis of the blackspot clusters revealed that there were 16 locations with the highest accident severity index (green), 69 locations with moderate severity (blue), and 153 locations with low severity (red).. These findings are summarized in (Figure 4) given below and in table 1 Therefore the locations of 16 Hotspots are given in Table 2 in Appendix

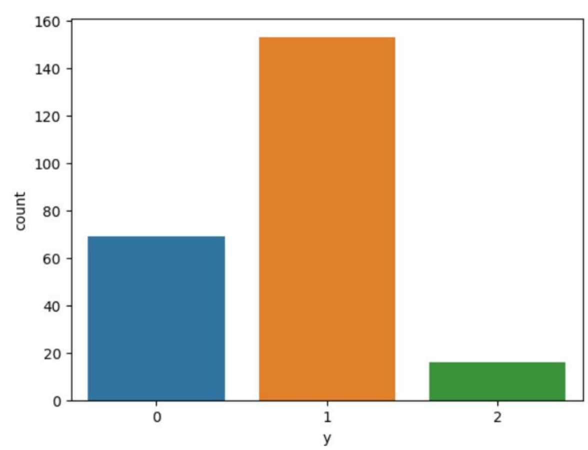

Figure 4: Charecteristics of blackspots chart

Table 1: Characteristics of Blackspots

Sl No.	Cluster Label	Count
1	0 - Low	153
2	1 - Moderate	69
3	2 - High	16

4 Conclusion and Recommendations

4.1 Conclusion

The identification and mapping of blackspots in Kerala using QGIS and k-means clustering provide valuable insights into areas that require targeted interventions for road safety improvements. By analyzing the clusters, we can understand the spatial distribution and severity of accidents, which is essential for effective decision-making and resource allocation.

4.2 Recommendations

Based on the analysis and findings, the following recommendations are proposed to improve road safety in identified blackspots:

- Enhance road infrastructure in blackspot areas, including speed calming measures, traffic signals, and signage.
- Strengthen enforcement measures to discourage reckless driving and speeding in blackspot areas.
- Increase police patrolling and surveillance in blackspot areas to deter potential accidents.
- Conduct targeted road safety awareness campaigns for drivers, pedestrians, and local communities in blackspot areas to promote safe behaviors.

By implementing these recommendations, it is expected that the occurrence of accidents in blackspot areas will be significantly reduced, leading to improved road safety and a safer transportation environment in Kerala.

5 Future Scope

Based on the findings from this study, the following future directions can be explored:

- Implement real-time monitoring systems that integrate accident data, traffic flow information, and weather conditions to proactively identify and mitigate potential blackspot areas using advanced analytics and machine learning techniques.
- Develop an integrated system where the car's infotainment system and airbag sensors can communicate with an app or software. In case of an accident where the airbag inflates, the system can automatically retrieve the nearest hospitals' data from the blackspot database and initiate contact with them or send an emergency message with the accident location.
- Foster collaborative partnerships among government agencies, research institutions, and technology providers to facilitate knowledge sharing, standardization, and innovation in blackspot identification and road safety.

By pursuing these future directions, we can improve our understanding of blackspots, enhance road safety, and work towards safer road environments with reduced accidents.

5.1 References

- `http://roadsafety.kerala.gov.in/blackspot`
- `https://keralapolice.gov.in/crime/road-accidents`

6 Appendix

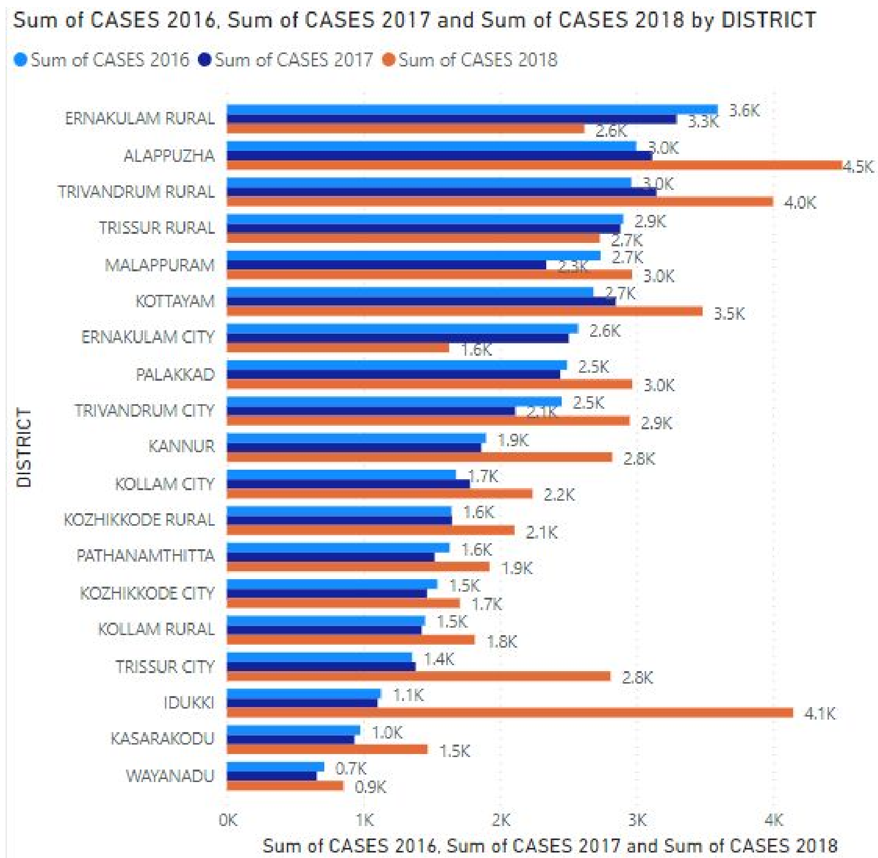

Figure 5: Sum of accident cases from 2016 to 2018

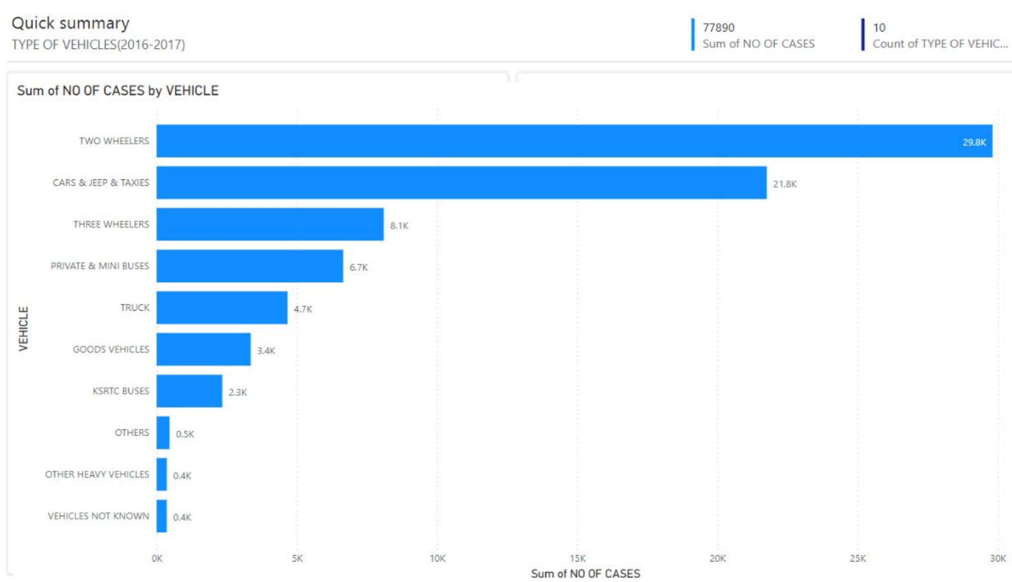

Figure 6: Sum of number of cases by vehicle type

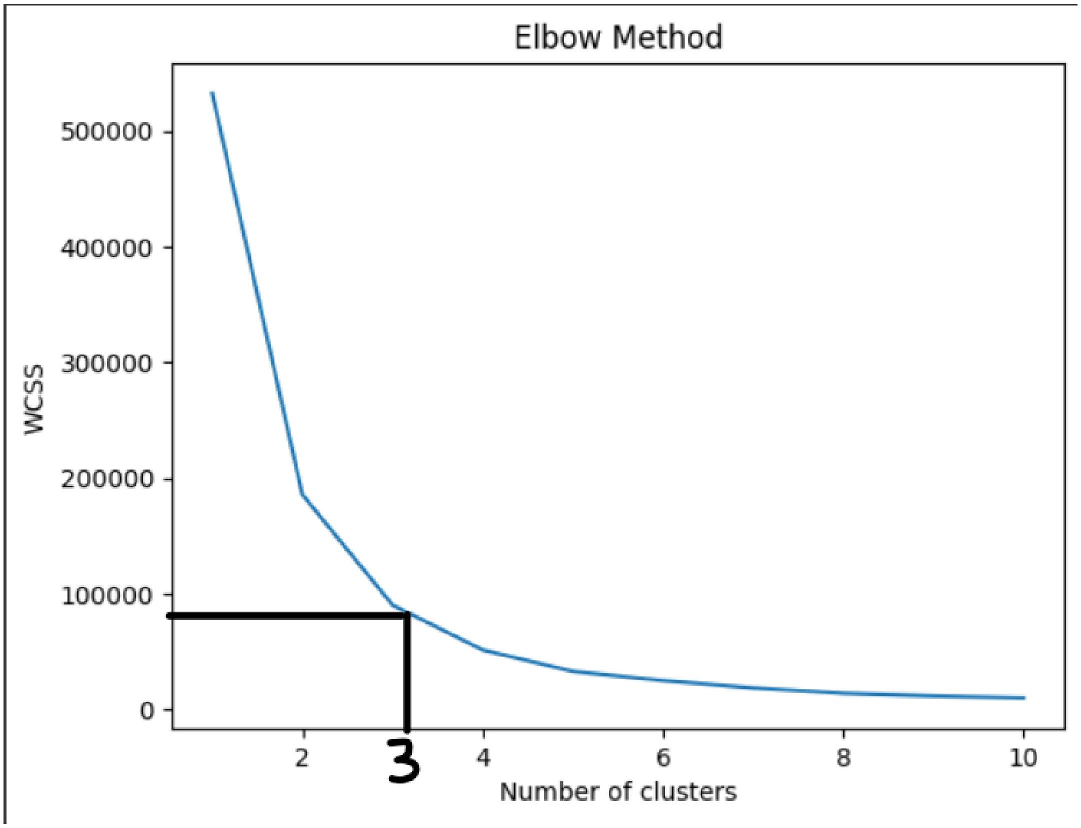

Figure 7: Sum of number of cases by vehicle type

Table 2: 16 Hotspots Locations

Sl. No.	Name of Location	Latitude	Longitude	Accident Severity Index	Number of Fatalities	Sum of Fatal & Grievous Injury Crashes
1	Pappanamcode Junction	8.47045988	76.98080277	366	15	102
2	Parimanam Temple	8.954697667	76.53427424	357	17	99
3	Karamana Junction	8.28447492	76.57566856	314	12	94
4	Kuttipuram Highway Junction	10.84280986	76.03002053	306	14	86
5	Balaramapuram Junction	8.430501136	77.04641733	300	6	92
6	Angamali Junction	10.1930052	76.38685187	297	12	83
7	Thuravoor Junction	9.768810399	76.31824372	275	9	73
8	Chandiroor	9.850948098	76.30738311	264	16	68
9	Ashramam, Karuvatta South	9.313443649	76.42901328	262	18	66
10	East Fort Junction	8.484180593	76.9476251	250	10	70
11	Edapallykotta	9.01189413	76.53674286	249	16	67
12	Junction	9.059008977	76.53564484	248	8	72
13	Aroor Main Junction	9.878483483	76.3040851	243	14	65
14	Overbridge Junction	8.4793257	76.94742853	241	10	67
15	Eranjippalam Junction	11.27950834	75.78433153	236	11	64
16	Killipalam Junction	8.481607373	76.95858756	234	9	66