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Visualization and Analysis of Road Accidents

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Abstract: *Road accidents are still a major cause of death and injury which also report large scale human and economic losses. We present to you our in-depth Road Accident Analysis Dashboard which we put together using Microsoft Excel and which we have used to look at and present road accident data from 2019 to 2022. The data we looked at includes 660,679 reports of accidents which we broke down into 12 key areas which included accident severity, road and weather conditions, vehicle type and area type. The dashboard we put together gives out action-based insights on total casualties, annual accident trends, severity of accidents and the role of road surface and light conditions, and vehicle types play in the outcome of an accident. We found out that 85.34% of accidents are of slight nature, 13.35% are serious and 1.31% are fatal and that cars are by far the largest factor in accidents.*

Keywords: Road Accident Analysis, Data Visualization, Casualty Statistics, Road Safety, Accident Severity, Traffic Analysis**.**

I. INTRODUCTION

Road accidents are a global public health issue which reports approximate 1.35 million deaths per year based on the World Health Organization. Also, we see that millions more are left with life time disabilities and economic problems as a result of038; didn't fatal that is. What we are seeing is a large scale in developing countries and also in urban areas which is a result of rapid urbanization, growing number of vehicles and insufficient road infrastructure. Also, we have that present accident report systems which put out raw data in table form which is hard for policy makers and analysts to quickly make sense of. There is a great demand for interactive, visual and data-based tools which will simplify the analysis of accident data and in turn support research-based solutions.

This study is about a Road Accident Analysis Dashboard. It was made using Microsoft Excel. The people who made it used a lot of data. 660,679 Records. That they got over four years from 2019 to 2022. The Road Accident Analysis Dashboard helps people look at how bad accidents are. They can see when accidents are most likely to happen. They can also see how the type of vehicle the road surface and the weather affect what happens in an accident. The Road Accident Analysis Dashboard even shows what is happening with accidents from one year, to the next with the Road Accident Analysis Dashboard.

II. PROBLEM STATEMENT

Road accident data is usually collected in spreadsheets with hundreds of thousands of records. This data can be really hard to understand without the tools. Road safety authorities' urban planners and researchers struggle to get information from these datasets. Some of the challenges are:

- Figuring out which accident types, like Fatal, Serious or Slight happen often and what causes them.
- Understanding how road surface, weather and lighting affect how often and how badly accidents happen.
- Finding out which types of vehicles are involved in the casualties.
- Looking at how accidents and casualties change over time to see if safety policies are working.
- Creating an interactive visual dashboard to show findings to people who are not experts.

The goal is to make it easy for everyone to understand road accident data. This can help improve road safety and make our roads better. By analyzing this data, we can identify areas for improvement. Road safety authorities can use this information to make decisions. It can also help urban planners design roads. Researchers can use this data to study and find ways to prevent accidents. Without a systematic analytical approach, critical patterns in accident data remain hidden, leading to reactive rather than proactive road safety measures.

III. OBJECTIVE OF THE SYSTEM

The main objectives of this study are as follows:

1. Analyze road accident data from 2019 to 2022 comprising 660,679 records to identify key trends and patterns.
2. Visualize total casualties, accident severity distribution, and year-wise comparison using an interactive Excel dashboard.
3. Assess the impact of road surface conditions, light conditions, weather, and vehicle types on accident severity and casualty counts.
4. Provide a user-friendly interface with filters (slicers) for stakeholders to explore data by year, severity, and area type.
5. Support data-driven decision-making for road safety authorities and traffic management organizations.

IV. LITERATURE REVIEW

Considerable research has been conducted on analyzing road accident data to identify patterns and support safety interventions. Evans (2004) provided foundational insights into traffic safety and the role of statistical analysis in understanding accident causation. The study emphasized that data-driven approaches are essential for designing effective road safety policies. Bliss and Breen (2009) studied global road accident trends and proposed systematic approaches for reducing road fatalities, stressing the importance of monitoring accident data across multiple dimensions including road type, severity, and vehicle category. Hosseinpour et al. (2014) analyzed the influence of road geometry, surface conditions, and environmental factors on accident severity. Their findings highlighted that wet and icy road surfaces significantly increase accident risk. Mussone et al. (2017) investigated urban versus rural accident patterns and found that urban areas experience higher accident frequencies due to traffic density, while rural accidents tend to be more severe due to higher speeds. Gutierrez-Osorio and Pedraza (2020) reviewed modern data-driven approaches for road accident analysis. The authors emphasized the growing role of interactive dashboards and visualization tools in translating raw accident data into actionable insights for policymakers. Rolison et al. (2020) studied accident severity contributing factors including vehicle type, lighting conditions, and weather. Their research found that motorcycles and two-wheelers face disproportionately higher fatality risks compared to four-wheelers.

V. DATASET DESCRIPTION

The dataset used in this study is a cleaned road accident dataset containing 660,679 records from 2019 to 2022. Each record captures detailed information about individual accident events. The dataset includes the following 12 key attributes:

TABLE I

Column Name	Description
Accident_Severity	Categorized as Fatal, Serious, or Slight
Accident Date	Date of the accident occurrence
Year	Year of the accident (2019–2022)
Light_Conditions	Daylight or Darkness at time of accident
Number_of_Casualties	Total number of casualties per accident
Number_of_Vehicles	Total number of vehicles involved

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Road_Surface_Conditions	Dry, Wet, Frost/Ice, Snow, or Other
Road_Type	Single Carriageway, Dual Carriageway, Roundabout, etc.
Urban_or_Rural_Area	Classification of accident location (Urban/Rural)
Weather_Conditions	Fine, Raining, Snowing, Fog, or Other
Wind Condition	Wind presence during the accident
Vehicle Type	Car, Bike, Bus, Goods Van, Agriculture, Other

VI. METHODOLOGY

The Road Accident Analysis Dashboard was developed following a structured data analysis and visualization pipeline:

1. Data Collection: The cleaned dataset of 660,679 road accident records was obtained and loaded into Microsoft Excel.
2. Data Preprocessing: The data was verified for consistency. Columns were validated for correct data types, and duplicate or null records were removed in the cleaning phase.
3. Pivot Table Analysis: Microsoft Excel Pivot Tables were used to aggregate accident counts, casualty totals, and vehicle involvement by multiple dimensions including year, severity, road type, and weather condition.
4. Dashboard Design: An interactive Excel dashboard was designed with charts, KPI cards, and slicers. Slicers allow dynamic filtering by year, accident severity, and urban/rural classification.
5. Visualization: Bar charts, line graphs, donut charts, and tree maps were used to represent key findings including year-wise trends, severity breakdown, and casualties by road and weather conditions.

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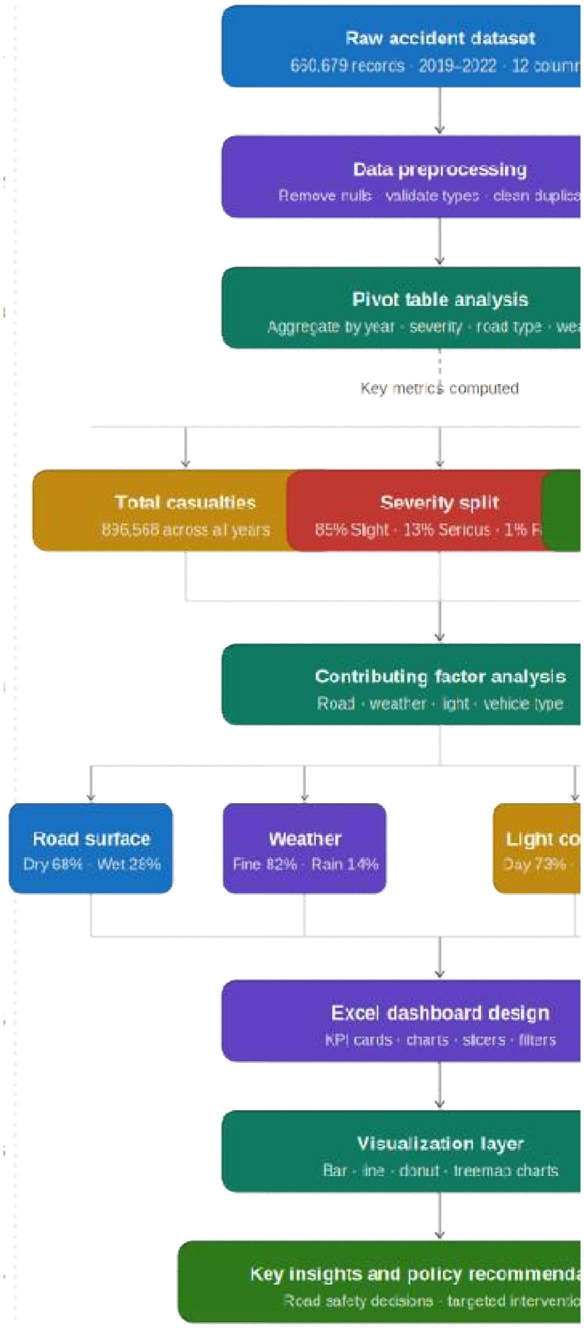

Fig. 1 System Flowchart – Road Accident Analysis Pipeline

VII. RESULTS AND DISCUSSION

The analysis of the Road Accident Dataset from 2019 to 2022 produced the following key findings:

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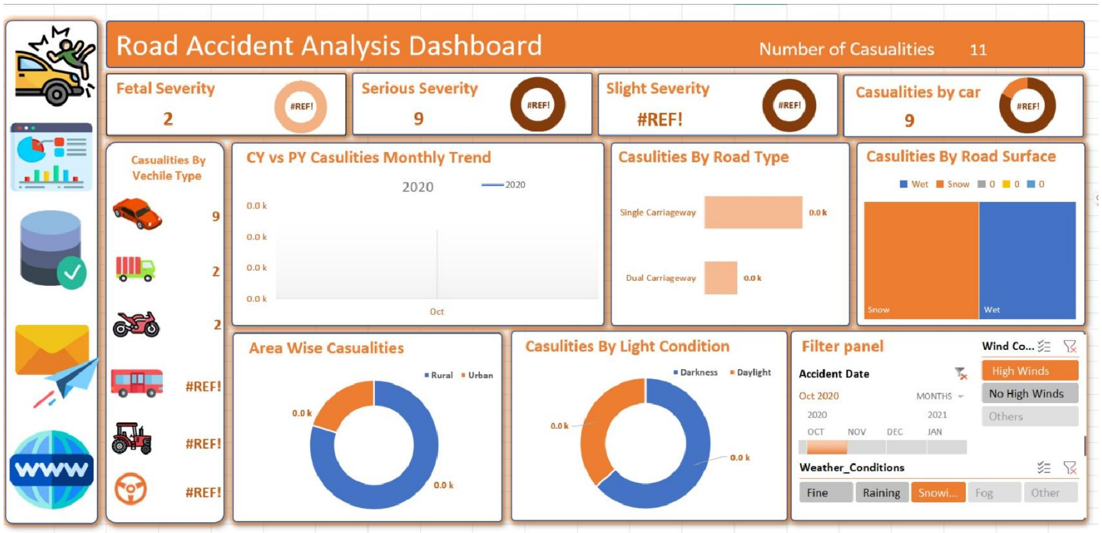

Fig. 2 User Dashboard for Road Accident Visualization & Analysis

A. Overall Statistics

The dataset contains 660,679 total accident records and 896,568 total casualties across all four years. The average number of casualties per accident is 1.36, and 1,209,872 vehicles were involved in total across all recorded incidents.

TABLE II: Overall Dataset Summary Statistics

Metric	Value
Total Accident Records	660,679
Total Casualties	896,568
Total Vehicles Involved	1,209,872
Average Casualties per Accident	1.36
Years Covered	2019 – 2022

B. Year-Wise Accident and Casualty Trends

A consistent downward trend was observed in both accident counts and total casualties across the four-year period, suggesting a positive impact of road safety interventions over time.

TABLE III: Year-Wise Accident and Casualty Count

Year	Total Accidents	Total Casualties
2019	182,115	247,780
2020	170,591	230,905
2021	163,554	222,146
2022	144,419	195,737

C. Accident Severity Distribution

The majority of accidents (85.34%) were classified as Slight, followed by Serious (13.35%) and Fatal (1.31%). Despite the small proportion of fatal accidents, they account for a significant source of preventable deaths. Single carriageway roads accounted for 6,527 out of 8,661 (75.4%) of all fatal accidents, making road type a critical factor in fatality risk.

D. Casualties by Vehicle Type

Cars were responsible for the highest number of casualties (694,887), accounting for approximately 77.5% of all casualties. Goods Vans and Bikes followed with 77,976 and 75,680 casualties respectively. Agricultural vehicles, while rare in accident records (1,947 vehicles), recorded a disproportionately high casualty average per incident.

E. Impact of Road Surface Conditions

Accidents on dry roads accounted for 447,821 incidents, which is the highest count. However, wet road conditions (187,725 accidents) represent a significantly elevated risk factor relative to the proportion of time roads are wet. Frost or ice conditions (18,517) and snow (5,890) also contributed to notable accident rates, emphasizing the need for seasonal safety interventions.

F. Light and Weather Conditions

484,880 (73.4%) of accidents occurred in daylight, while 175,799 (26.6%) occurred in darkness. Fine weather accounted for 543,567 accidents, while raining conditions contributed to 89,311 accidents. Fog, though accounting for only 3,528 accidents, is associated with disproportionately severe outcomes due to reduced visibility.

G. Urban vs. Rural Area Analysis

Urban areas recorded 421,663 accidents (63.8%), significantly more than rural areas (238,990; 36.2%). However, rural accidents tend to involve higher speeds and are more likely to result in serious or fatal injuries, highlighting the need for targeted rural road safety measures.

VIII. CONCLUSION

From 2019 to 2020 we saw a steady decrease in accident frequency and number of casualties; in that same time frame there was a tendency of very minor incidents to be the large group at 85.34%; cars which are used by the drivers are mostly what we see in reports for casualties; it also came out that single carriageway roads are the most risky for fatal accidents; wet and icy road conditions report as the main environment related issue.

The dashboard demonstrates that data-driven tools can significantly enhance the speed and quality of road safety decision-making. It offers a scalable, cost-effective solution for organizations that require actionable insights from accident data without the need for specialized software.

IX. FUTURE SCOPE

The current system demonstrates promising results in road accident analysis; however, several enhancements are possible in future iterations:

• The dashboard can be migrated to Power BI or Tableau for real-time data refresh capabilities and more advanced interactive filtering.

• Integration with live government traffic databases and IoT sensor data would allow for real-time accident monitoring and early warning systems.

• Machine learning models (e.g., decision trees, random forests) can be applied to predict accident severity based on prevailing road, weather, and vehicle conditions.

• The analysis can be extended to include geospatial mapping, allowing accident hotspots to be visualized on interactive maps for targeted infrastructure improvements.

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• Expansion of the dataset to include more recent years and additional countries would improve the generalizability and policy relevance of the findings.

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