Rome Safe Roads

Visual Analytics project
2023-2024

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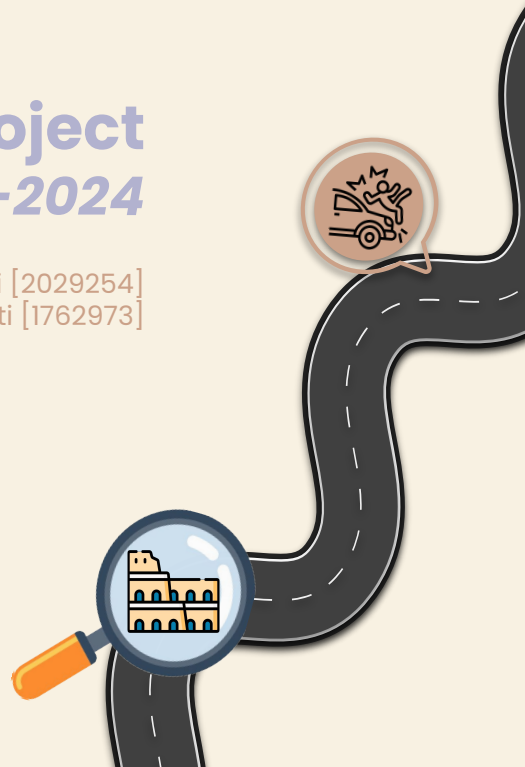


01

Overview

Topic

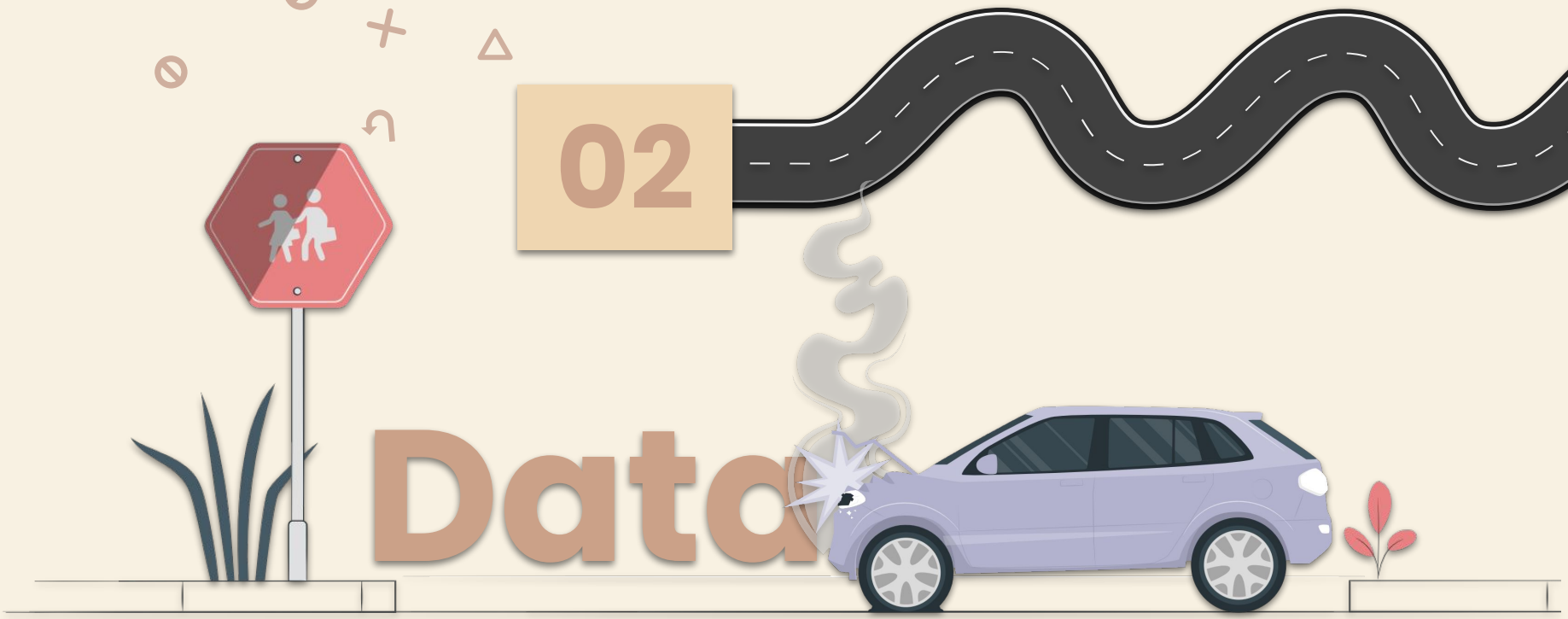
Rome Safe Roads

Road accidents are a significant contributor to global mortality and injuries.
In a bustling metropolis like Rome, an average of 79 accidents occur daily, resulting in 0.3 fatalities and 100 injuries.

The study and analysis of traffic accidents can provide valuable insights for Rome Municipality into the underlying causes, consequences, and risk factors associated with these incidents, ultimately aiding the development of effective road safety strategies.

02

Data



Data sources 1/2

The data was collected from the official website of the Municipality of Rome (Road accident dataset).

The website contains data available in several formats (*xml, json, csv*) and grouped by month.
For the conducted analyses only *.csv* files have been considered.

Some main fields in the chosen dataset are the following:

- *Protocollo*
- *DataOraIncidente*
- *NaturaIncidente*
- *particolaritastrade*
- *TipoStrada*
- *FondoStradale*
- *Pavimentazione*
- *Segnaletica*
- *CondizioneAtmosferica*
- *Traffico*
- *Visibilita*
- *Illuminazione*
- *NUM_FERITI*
- *NUM_RISERVATA*
- *NUM_MORTI*
- *NUM_ILLESI*
- *Longitude*
- *Latitude*
- *StatoVeicolo*
- *TipoVeicolo*
- *TipoPersona*
- *Sesso*
- *Tipolesione*
- *Deceduto*
- *DecedutoDopo*
- *CinturaCascoUtilizzato*
- *Airbag*

Data sources 2/2

The entire data source used for the system has the following dimensions for each year:

- 2019 contains 79.283 tuples
- 2020 contains 54.222 tuples
- 2021 contains 73.100 tuples
- 2022 contains 47.060 tuples

Therefore, the total number of tuples given by summing all the four years is 253.665 while 37 are the attributes.

The **AS** (*AngeliniSantucci*) **Index** of the dataset defined as:

AS = #tuples × #dimensions → AS = 253.665 × 37 = 9.385.605

Data pre-processing

PCA

Variables choice for clustering, based on accidents' severity, in two dimensions

DATE

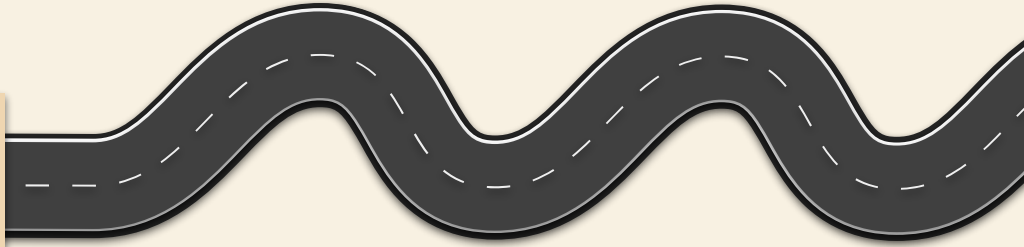
Data organizing in time unit and accident counting

DISTRICT

Fatal or general accident counting and grouping by district

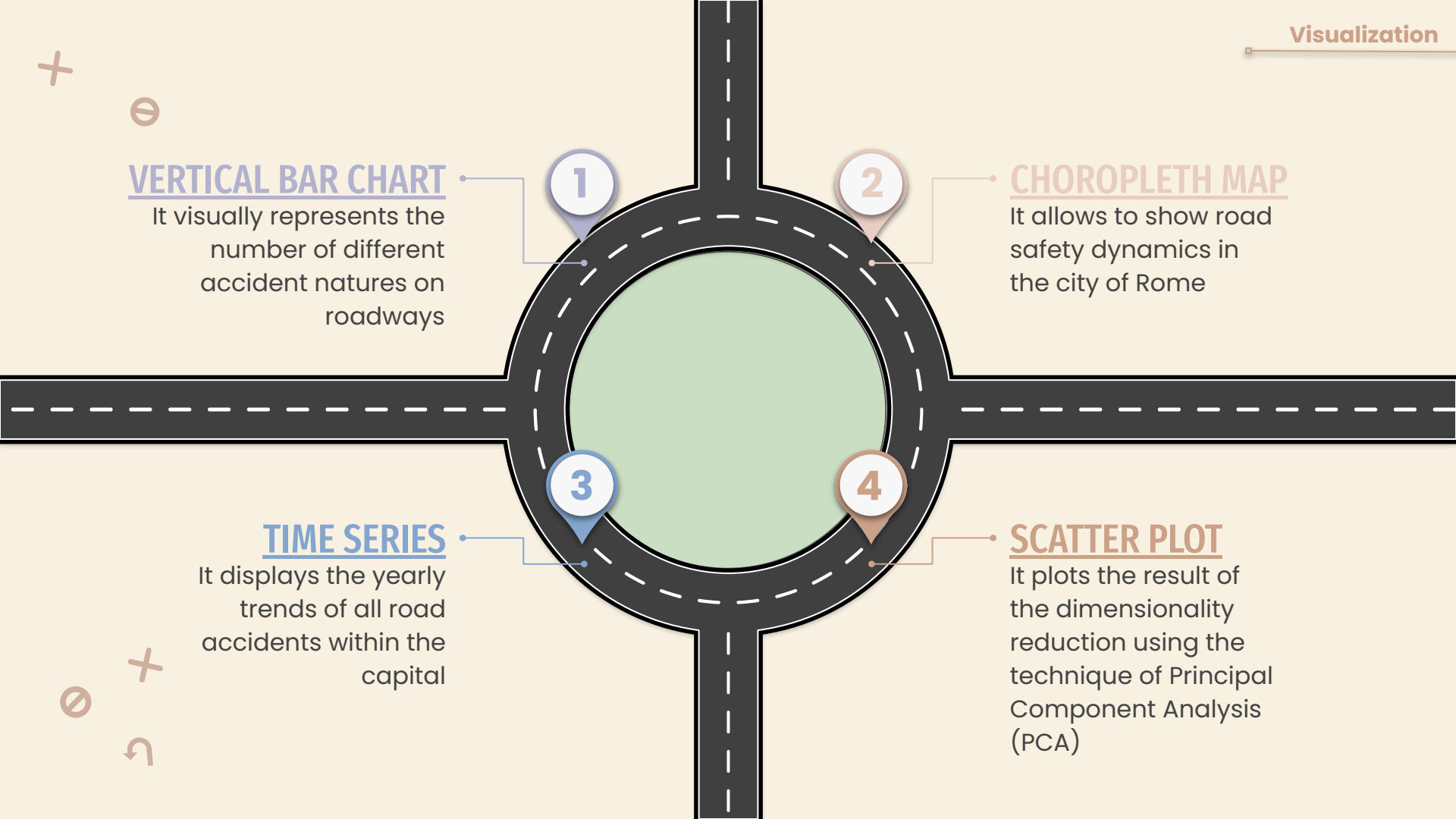
ACCIDENT NATURE

Data filtering and grouping by different natures



03

Visualizations



VERTICAL BAR CHART

It visually represents the number of different accident natures on roadways

CHOROPLETH MAP

It allows to show road safety dynamics in the city of Rome

TIME SERIES

It displays the yearly trends of all road accidents within the capital

SCATTER PLOT

It plots the result of the dimensionality reduction using the technique of Principal Component Analysis (PCA)

Vertical Bar Chart

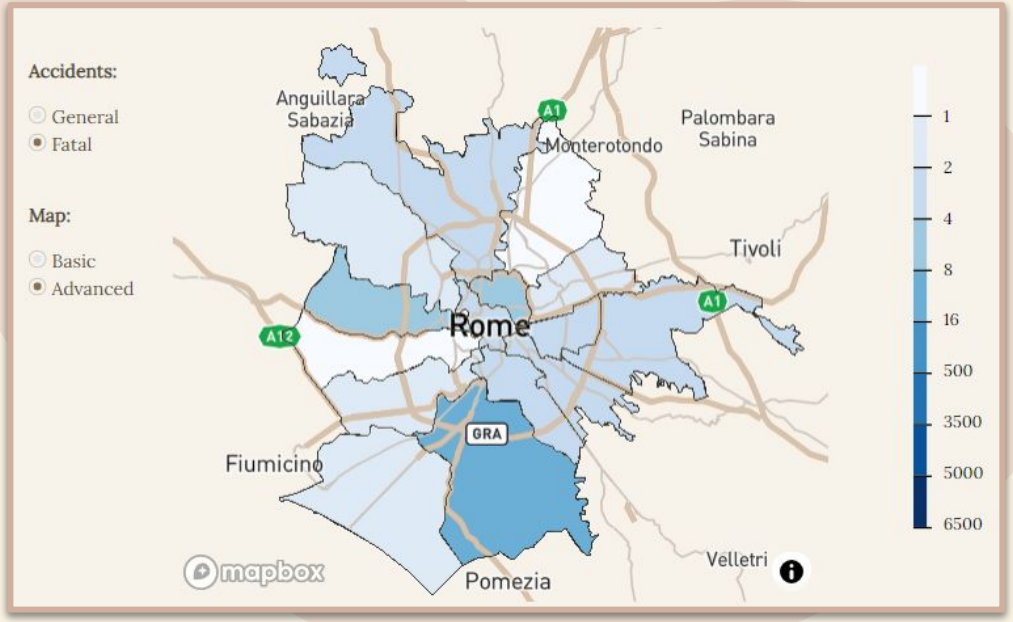
Visualization

By organizing accident natures along the x-axis and quantifying them on the y-axis, the chart provides an overview of the number of the occurred accidents for each nature.

Insights

- Weather conditions influence
- Critical accidents nature

Choropleth Map



Visualization

The chart consists of a map subdivided into 15 districts, each characterized by an associated color representing the number of general or fatal accidents that occurred within its geographic boundaries.

Insights

- Safer Districts
- Star-shaped of accidents concentration
- Critical streets and crossroads

Time Series

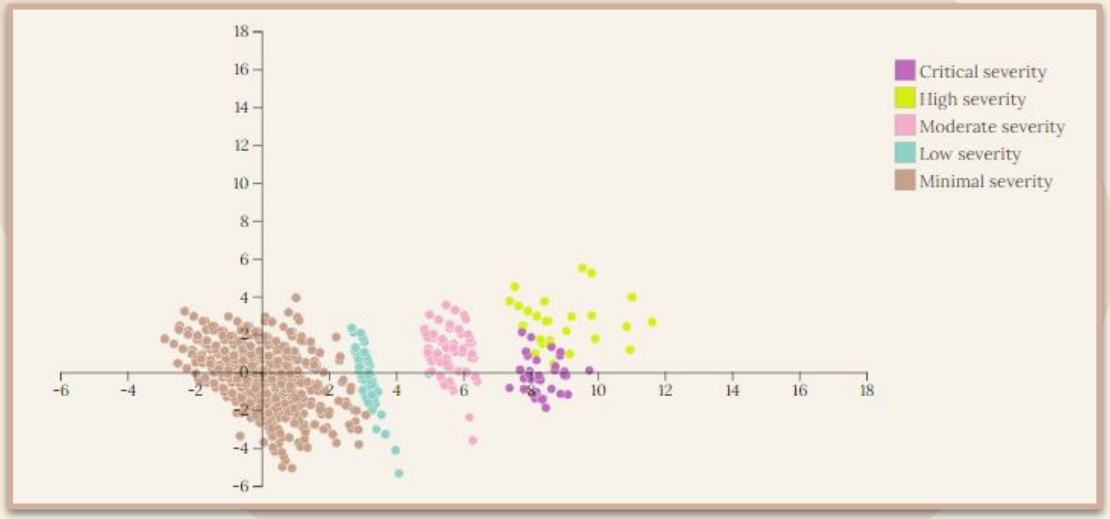
Visualization

The chart offers a temporal perspective. The time is represented on the x-axis while the y-axis quantifies the number of accidents, visualizing the continuous evolution of accidents throughout the year.

Insights

- Peaks comparison
- Curve dip in summer season
- Impact of Lockdown on Road Accidents in 2020

Scatter Plot



Visualization

The chart plots the result of the dimensionality reduction using the technique of Principal Component Analysis (PCA). The points are represented based on two dimensions. In this way it is possible to see which accidents are similar and which are outliers.

Insights

- Cluster patterns based on severity accidents
- Presence of eventual outliers in some clusters

04

Analytics

Dimensionality reduction

Principal Component Analysis

The analytical process is focused on applying Principal Component Analysis (PCA) real time on demand as a technique for dimensionality reduction. That was possible developing a backend service deployed on a server with the support of Flask framework.

Steps needed are the following:

- Dataset preprocessing including the handling of missing data, feature normalization and outlier management
- Data standardization
- Selection of two principal components to compute PCA. The key variables identification is based on observed variance

The resulting visualization provides a perspective on the correlation between different factors such as traffic intensity, fatalities, injuries and more.

05

Application & utilities

Intended user

The Rome Safe Roads system can be used as an asset for the dedicated members of the Polizia Locale di Roma.
It offers a comprehensive tool for enhancing the operational efficiency and decision-making capabilities.

The system can be considered a force source, enabling to strategically allocate resources where they are needed most.

By identifying critical areas and accident natures, the Polizia Locale di Roma can optimize their own utility and interventions, ensuring a customized and effective approach to enhancing road safety.

Application cases

Preventive traffic management

Polizia Locale di Roma and traffic authorities enhance road safety through Rome Safe Roads data analysis, signal improvements, and awareness campaigns.

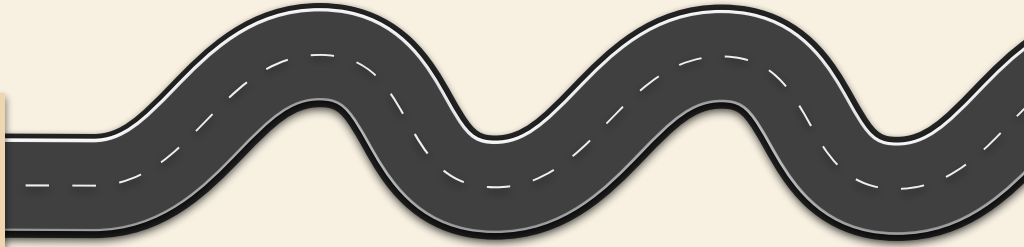
1

Pedestrian safety in urban environment

Polizia Locale di Roma deploys safety pedestrian plan using Rome Safe Roads data to monitor and adapt strategies based on accident analysis.

2

05



Future Perspectives

Future Improvements

Traffic city management

Urban planning and integration with transport agencies allows faster interventions in specific situations

IoT Integration

Responsive Traffic Management with Advanced Sensors

Collaborative research

Partnering with authorities for a more accurate dataset.

References 1/3

Dataset

[1] Comune di Roma. Traffico stradale di Roma. Open Data del Comune di Roma.(2022). https://dati.comune.roma.it/catalog/dataset/d108

Tools

[2] Cynthia Brewer, Mark Harrower and The Pennsylvania State University, ColorBrewer (Version 2.0) [Source Code]. https://colorbrewer2.org

[3] Openpolis. (2023). Geojson-italy. https://github.com/openpolis/geojson-italy

[4] Pedregosa, F., Varoquaux, G., Gramfort, A., Michel, V., Thirion, B., Grisel, O., ... & Vanderplas, J. (2011), Scikit-learn (Version 1.3.2)[Source Code]. https://github.com/scikit-learn/scikit-learn

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[6] Wes McKinney, Pandas (Version 0.25.3) [Source Code]. https://pandas.pydata.org/

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[8] MapBox contributors, MapBox (Version 3.2.0) [Source Code]. https://www.mapbox.com/

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Related works

[9] Antonio Comi, Antonio Polimeni, Chiara Balsamo, Department of Enterprise Engineering, University of Rome Tor Vergata, 00118 Rome, Italy, Road Accident Analysis with Data Mining Approach: evidence from Rome from 24th Euro Working Group on Transportation Meeting (2022), edited by Margarida Coelho, volume 62, pages 798-805. [Online] Available: https://www.sciencedirect.com/science/article/pii/S2352146522002265?ref=pdf_download&fr=RR-2&rr=83f4d021eb03bb0b

[10] J.J. Rolison, S. Regev, S. Moutari, A. Feeney, What are the factors that contribute to road accidents? an assessment of law enforcement views, ordinary drivers' opinions, and road accident records (2018) [Online] Available: https://www.sciencedirect.com/science/article/pii/S0001457518300873

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How can be Rome Safe Road system be located with respect to existing literature?

Existing literature mainly predicts accidents based on drivers behavior and vehicle types, overshadow road factors. Rome Safe Road analyzes accident causes and dynamics for tailored prevention measures.

References 3/3

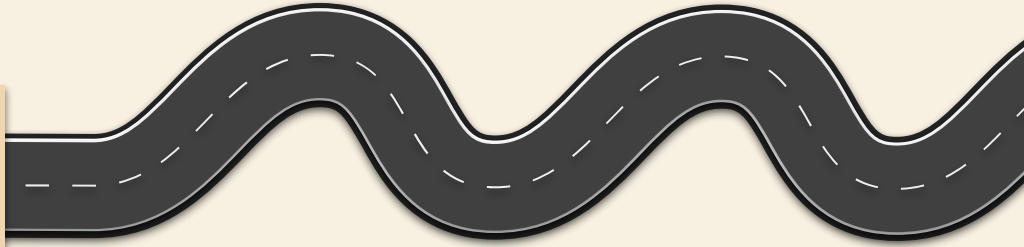
The entire work is published on the GitHub page

Tap here

- Discover the **live version** of the project running the server file /app.py and reaching the following link: http://localhost:63342/visual-analytics/index.html
- A detailed **scientific paper** have been realized to provide a complete project documentation: https://github.com/2029254/RomeSafeRoads/blob/main/docs/ScientificPaper.pdf

Innovation begins with collaboration.
Share your thoughts!

THE END



Thank you for the attention!

Let’s go to the demo!