DECODING THE ROADS: AN INFRASTRUCTURE-DRIVEN MACHINE LEARNING APPROACH TO PREDICT SAFETY

AI for Vision Zero in Road Saefty

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Introduction

- **The Route2School Project** gathers subjective safety perceptions related to home-school journeys, collecting data from over 80 cities and more than 1,000 schools across Flanders, Belgium.

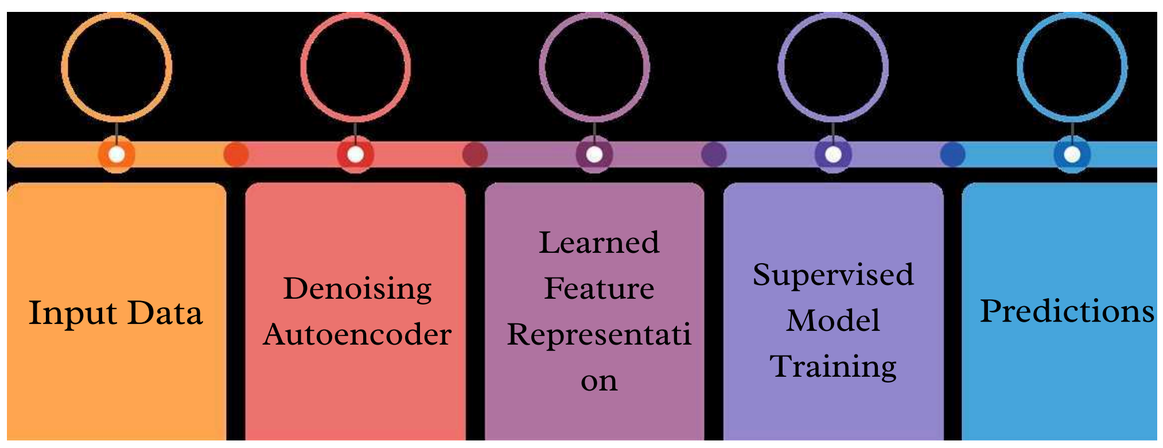
Snapshot of the R2S data

Objective

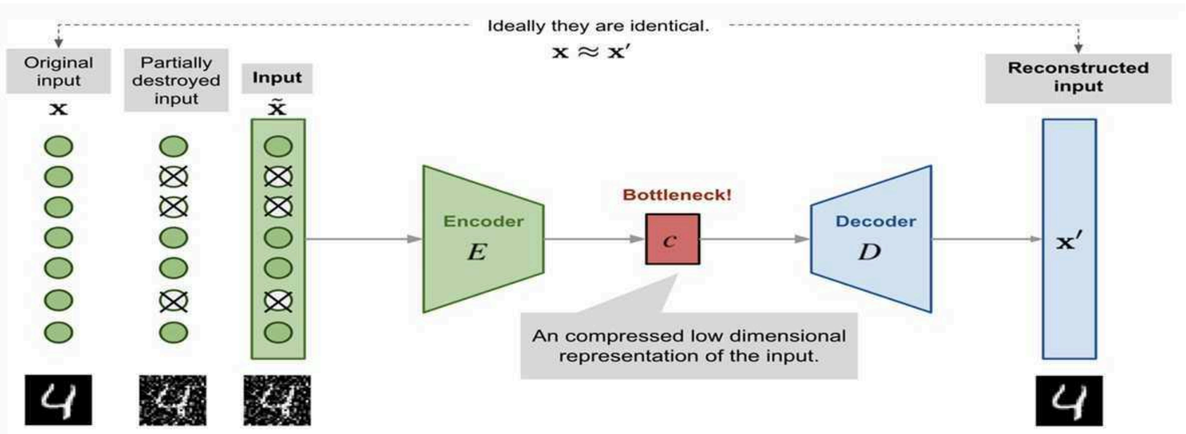
The primary research question guiding this study is: **Can subjective safety be quantified through the attributes of a road network?**

Methodology

Semi-supervised framework leveraging a special type of Autoencoders called Denoising Autoencoders (DAE).



Denoising Autoencoder: Overview



Source: towardsdatascience.com (https://towardsdatascience.com/autoencoders-and-the-denoising-feature-from-theory-to-practice-db7f7ad8fc78/)

Experimental Setup

- Bottleneck Layer Dimension – 16
- Hidden Layers – One hidden layer with dimension 100
- Input Corruption – Corrupt only observed values to make the model aware of missingness
- Loss Function – Combination of Mean Squared Error and Cross-Entropy loss
- Downstream Supervised Model – Gradient Boost

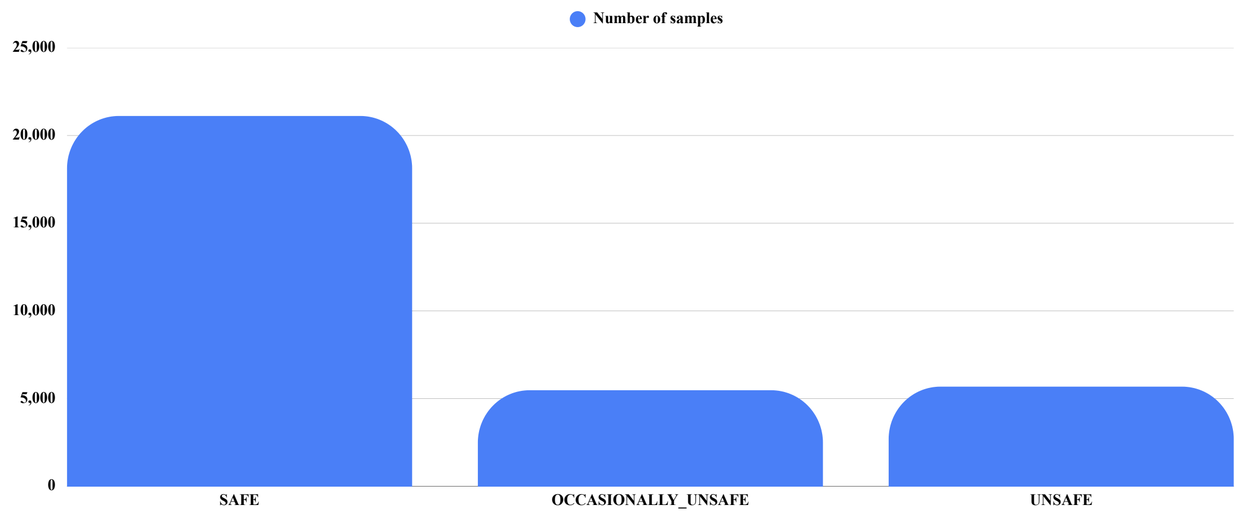
Results

Evaluation Metrics	Weighted	Macro
Accuracy	0.77	-
Precision	0.76	0.73
Recall	0.77	0.56
F1 Score	0.74	0.61

Evaluation Metrics	Safe	Occasionally_Unsafe	Unsafe
Precision	0.78	0.70	0.70
Recall	0.95	0.34	0.40
F1 Score	0.86	0.46	0.51

Challenges

- Extensive Missingness in OSM Data
- Unequal Representation of Safety Categories



Conclusion

- Accurately classified unsafe areas 73% of the time, aiding road safety engineers in minimizing resources spent on false positives.
- Utilizes OpenStreetMap (OSM) data for easy adaptation in different regions, needing only local safety labels for calibration.
- Can assess safety in areas with limited crash data and integrate with routing systems to assist vulnerable road users.
- Limitations include the need for further optimization and challenges in interpreting specific OSM attributes related to safety

Acknowledgements

This project has received funding from the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie grant agreement No 101119590. The opinions expressed in this document reflect only the authors' view and in no way reflect the European Commission's opinions. The European Commission is not responsible for any use that may be made of the information it contains.

Funded by the European Union