MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 23-510 (project 669) | December 2023

Intelligent Safety Assessment of Rural Roadways Using Automated Image and Video Analysis

the ISSUE

Roadside safety is a critical aspect of transportation management, with elements like rigid obstacles, guardrails, clear zones, and side slopes significantly impacting accident outcomes. The Federal Highway Administration (FHWA) provides a valuable rating system for departments of transportation (DOTs), but the manual rating process is time-consuming and prone to inconsistencies.

the RESEARCH

This project introduces an innovative solution employing computer vision and machine learning algorithms to automate the roadside safety evaluation process. Utilizing pre-trained models such as VGG16 and images captured from Utah roadways, the research team develops a robust algorithm for automated safety evaluation that aligns with the FHWA rating system, providing a comprehensive and efficient method for assessing roadside conditions. Tailored computer vision algorithms detect specific features, enhancing the accuracy of safety evaluations. Pre-trained models for clear zone detection and roadside slope classification further contribute to a nuanced understanding of roadside elements. The methodology employs various computer vision algorithms to automatically rank roadside safety by detecting features such as guardrails, clear zones, rigid obstacles, and roadside slopes.

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A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

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Project Title

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the FINDINGS

Notable results include a guardrail detection model achieving 93% accuracy, a logistic regression model for rigid obstacle detection achieving 100% accuracy in identifying vegetation and embankments, and a combined model for detecting rigid roadside obstacles achieving 94% accuracy. Additionally, pretrained models have been developed for clear zone detection (83% accuracy) and classifying roadside slopes into low, mid, and high categories (94% accuracy). Utilizing the extracted features and developed algorithms, safety rankings were assigned to road segments on five state roads in Utah. The final product is a GIS shapefile containing safety rankings and details on roadside features at each interval along these roads.

The application of machine learning algorithms and computer vision technologies to assess roadside safety is a promising approach, yet several limitations and challenges must be addressed. These include dependency on high-quality roadside images, which may not always be readily available, a need for periodic retraining to remain effective, and the challenges of obtaining the necessary images. Further, there is a challenge concerning potential false positives and false negatives. Computer vision algorithms may misinterpret non-hazardous roadside features as hazardous or may miss actual hazards, leading to either unnecessary or overlooked road maintenance. Human verification is imperative before decisions are made to improve identified road segments. In addition, the model's design and training on rural imagery data limit its applicability to urban areas.

the IMPACT

The automated approach showcased in this research offers a promising avenue for strengthening roadside safety measures and preventing potential accidents. While acknowledging challenges such as periodic retraining and potential false positives, this approach stands as a promising addition to existing methods. The project's outcome is a shapefile containing safety rankings for road segments on five state roads. This tool empowers traffic engineers with data-driven insights, enabling informed decision-making for prioritizing improvement projects and enhancing road safety.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1151

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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