The University of Texas Rio Grande Valley
Center for Multidisciplinary Research Excellence in Cyber-Physical Infrastructure Systems (MECIS)

Detecting Hazards at Rail Grade Crossings Using Artificial Intelligence & Deep Learning

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Abstract

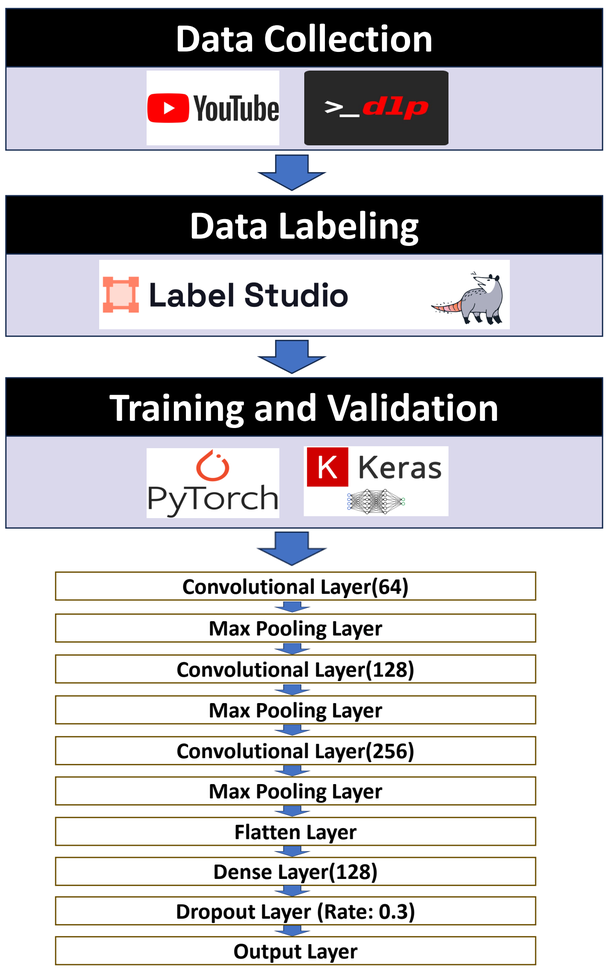
Grade crossings are pivotal for rail network safety as they pose significant collision risks between vehicles and trains. The National Highway Traffic Safety Administration reports indicated over 1,600 vehicle-train collisions and 500 human-train incidents in 2020 alone. Continuous efforts by research institutions, transportation agencies, and governmental bodies aim to enhance safety at these crossings through technologies such as sensors and depth cameras. This study explores the use of artificial intelligence (AI) & deep learning (DL) to develop computer vision models for hazard detection.

Introduction & Background

- 1,600 pedestrian-train and 500 vehicle-train collisions in 2020 [1].
- Need for a cost-effective and accurate detection method [2-4].
- Robustness under different conditions such as lighting, weather, type of train, visibility, and others.
- **GOAL:** Explore automated monitoring of grade-crossing hazards using deep learning.

Figure 1: Examples of Collected Grade Crossing Images.

Methodology



Data and Results

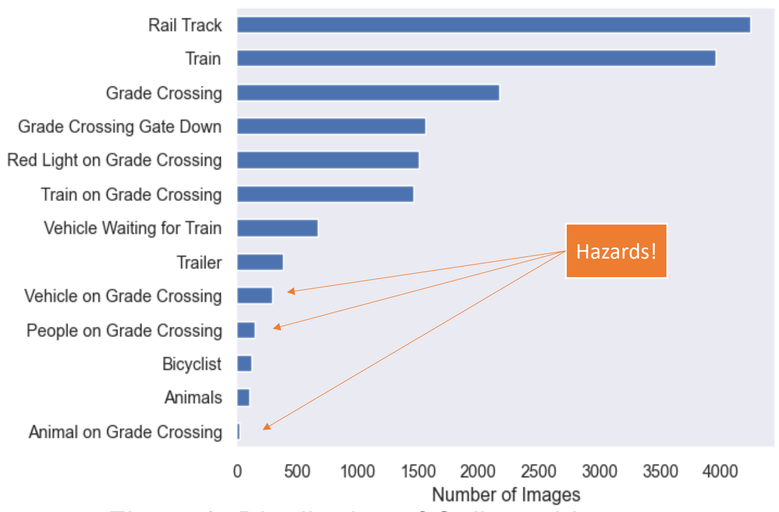


Figure 2: Distribution of Collected Images

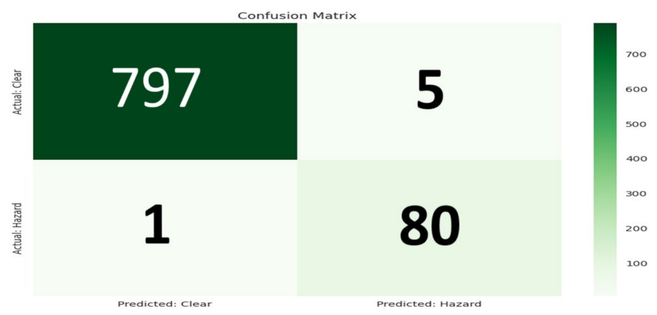
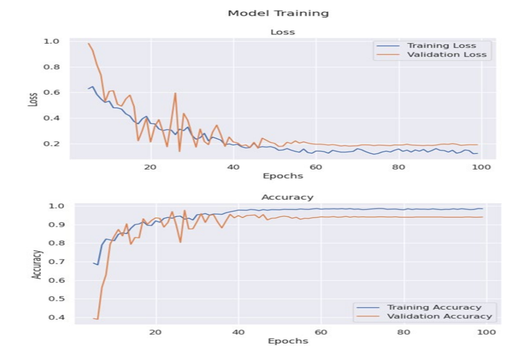


Figure 3: Confusion Matrix

Training and Validation Loss



Validation Results

	Label	TP	TN	FP	FN	Accuracy	Precision	Recall	F1-Score	AUC	Balanced Accuracy
1	Hazard	80	797	1	5	0.99	0.98	0.94	0.96	0.97	0.96

Conclusions & Future Work

- Optimal accuracy.
- Future Work:
  - Additional Testing
  - Testing model with live and simulated data.

Acknowledgments

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