ProxiRail: A Retrospective Risk-Detection System for Identifying Near-misses

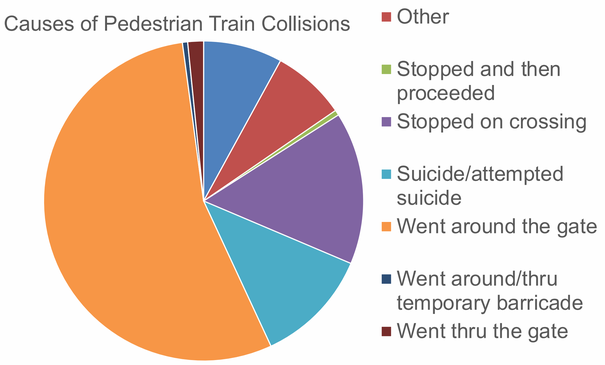
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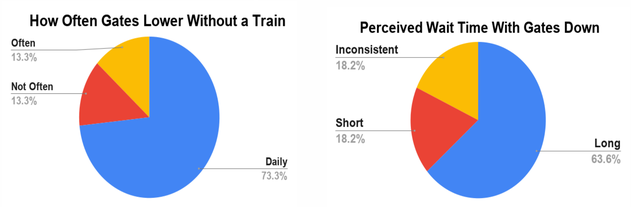
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BACKGROUND

This year 56% of train-pedestrian collisions occurred because of people jumping the rail crossing guards. We have only been recording the actual accidents yet hidden in this statistic there are even more near-misses because of people jumping the guards. Researchers are missing information and danger is going unnoticed.



Research Objective



We set out to build a tool to fill the gap in the necessary data that has been missing from transportation studies and safety efforts. With the objectives:

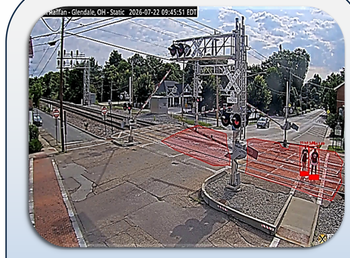
- To catalogue Pedestrian crossings only during high-risk events (such as, instances when railroad crossing gates activated)
- Quantify near-miss events on railroad tracks.

METHODS



Detect + ID Objects

Using YOLO and DeepOCSort in order to get consistent IDs and tracking across sequential frames



Geometric Test

Run an Intersection of Area geometric test to determine an objects position in relation to a segmented grade crossing zone.

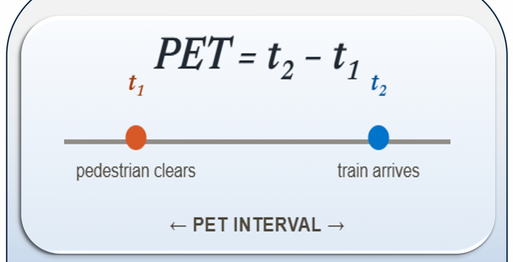


Track Conditions

Using a fine-tuned object detection model, whether a crossing gate is in the active position to determine when to start labelling objects at risk.

Record Exits

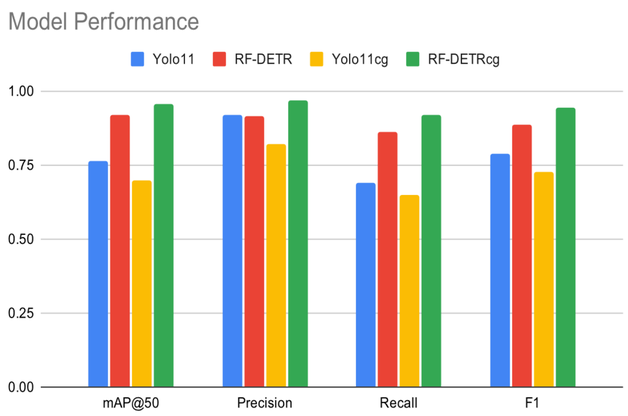
Whenever the IoA value from the geometric test switches from 1.0-0.0 an exit event is logged for that object.



Calculate PET

Once recorded exits are logged the program waits for the arrival of the train class to be true and logs the difference between exit event and train arrival.

RESULTS



- **CG** = Crossing gate version of detection model
- RF-DETR was the all-around better model when compared to YOLO 11 nano
- The models trained were the crossing gate variants for detection of humans and trains, pretrained models were used.

DISCUSSION

- Standard methods for track conditions have been established to be sampling pixel regions and extracting color values. Our method implemented fine-tuned computer vision models to detect track conditions which yielded 96.8% precision on the test-set
- We concluded that specializing object detection models to split up the tasks (detecting track conditions and detecting objects) would yield improved results rather than fine-tune and change the already pretrained weights on relevant classes
- RF-DETR and YOLO11 were comparable in terms of precision, yet in the mAP@50 RF-DETR was consistently more reliable in its detections
- Box resizing during detection was causing false positives

FUTURE WORK

- Incorporate TTC metrics / Dynamic risk levels and collision prediction with API integration
- City database/website cataloging near miss events
- Summary capabilities using compiled data to return dangerous intersections and common features of those intersections
- Predicting Pedestrian Intention & Movement

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