SmartWalk: AI-Based Pedestrian Detection and Driver Alert System for Intersection Safety

Ryan Calixte and Cassandra Glomann

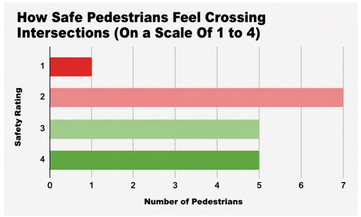
Advisors: Suvosree Chatterjee, Jenifar Selim, Sara Sevilla, Dr. Serena Hoermann, and Dr. Jason Hallstrom

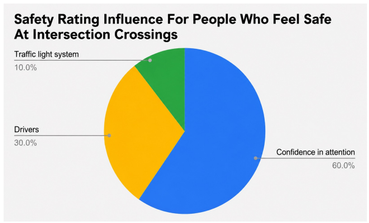
BACKGROUND

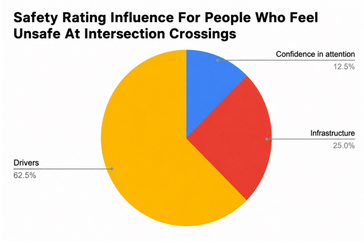
Throughout West Palm Beach, road safety continues to be a growing concern, statistically prevailing in urban communities at intersections where vehicles and pedestrians intersect.1

1. **Primary issue:** Pedestrian visibility at intersections.
2. As attention span decreases, pedestrian safety and agency will only get worse.

SmartWalk increases pedestrian visibility by detecting pedestrians at intersections, determining where they intend to move, and relaying that prediction to drivers, improving pedestrian agency at intersections.







METHODS

Pedestrian & Vehicle Detection (Pre-trained YOLOv8n) and Multi-Object Tracking (ByteTrack) via Python

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Crosswalk and Curb-Zone Identification (YOLOv8n)

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Pedestrian Movement Calculations and Pose Extraction (MediaPipe Pose)

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Crossing Intent Prediction Model (Train LSTM with Pexels video and self-recorded footage)

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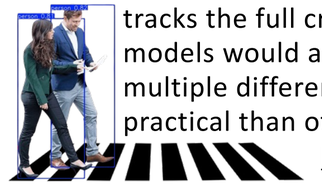
Pedestrian Risk/Vulnerability Calculation

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Alert Logic and Visual Display Outputting Results

DISCUSSION

Findings: **YOLOv11n** produced the least amount of error when generating crossing probabilities as part of the pedestrian intent model. In crosswalk identification, **YOLOv8n** was able to demonstrate better detection because it consistently tracks the full crosswalk it detects while advanced models would attempt to segment a crosswalk into multiple different crosswalks, making **YOLOv8n** more practical than other models in real-time deployment.



YOLOv8



YOLOv26



Limitations:

1. Small datasets **limit the accuracy** of models that predict behavior and intent.
2. ID-switching can lead to **gaps in training data** and require "manual tracking" (which is subject to human error).
3. Imbalances in training data can lead to **incorrect predictions** for underrepresented classes.

PROJECT GOALS

1. Develop a **reliable** AI system capable of accurately **detecting pedestrians** approaching crosswalks.
2. **Improve pedestrian confidence** when traveling along crosswalks and intersections.
3. **Increase driver awareness** when commuting on the road.
4. Provide pedestrians with agency, independence, and privacy by **protecting personally identifiable information**.

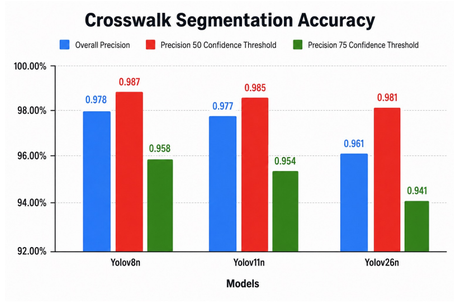
WEBSITE

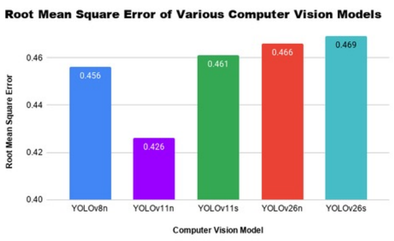
https://smartwalkresearch.netlify.app

RESULTS

Pedestrian and Vehicle Detection Model: Comparing the results of YOLOv8n, YOLOv11n, and YOLOv26n, **YOLOv26n** produced the highest precision levels when detecting pedestrians and vehicles.

Crosswalk Detection Model: Juxtaposing YOLOv8n, YOLOv11n, and YOLOv26n for crosswalk segmentation, **YOLOv8n** surprisingly produced the highest accuracy.





When comparing 5 different computer vision models, **YOLOv11n** generated the lowest **root mean square error** when predicting the crossing probabilities of pedestrians.

FUTURE WORK

1. Design a more sophisticated and appealing **visual and audio (V2I) system for drivers.**
2. **Expand beneficiaries** of the system beyond pedestrians and motorists (e.g. cyclists, pets, wildlife).
3. Add **face blur software** to protect personally identifiable information.

ACKNOWLEDGEMENTS

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2JayWatch, Crosswalk Dataset, Roboflow Universe, Nov. 2025. [Online]. Available: https://universe.roboflow.com/jaywatch-3cown/crosswalk-pmonv.