

Computer Vision for Crosswalk Activation: Pedestrian Detection Using AI

Meet the Team



Left-to-Right:

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Background

- Pedestrian fatalities in the U.S. have risen 80% since 2009, with over 8,000 pedestrians killed in 2022.
- Rapid rectangular flashing beacons, or RRFBs, reduce pedestrian crashes by 47%.
- However, manual activation with push buttons are slow and lack user trust.



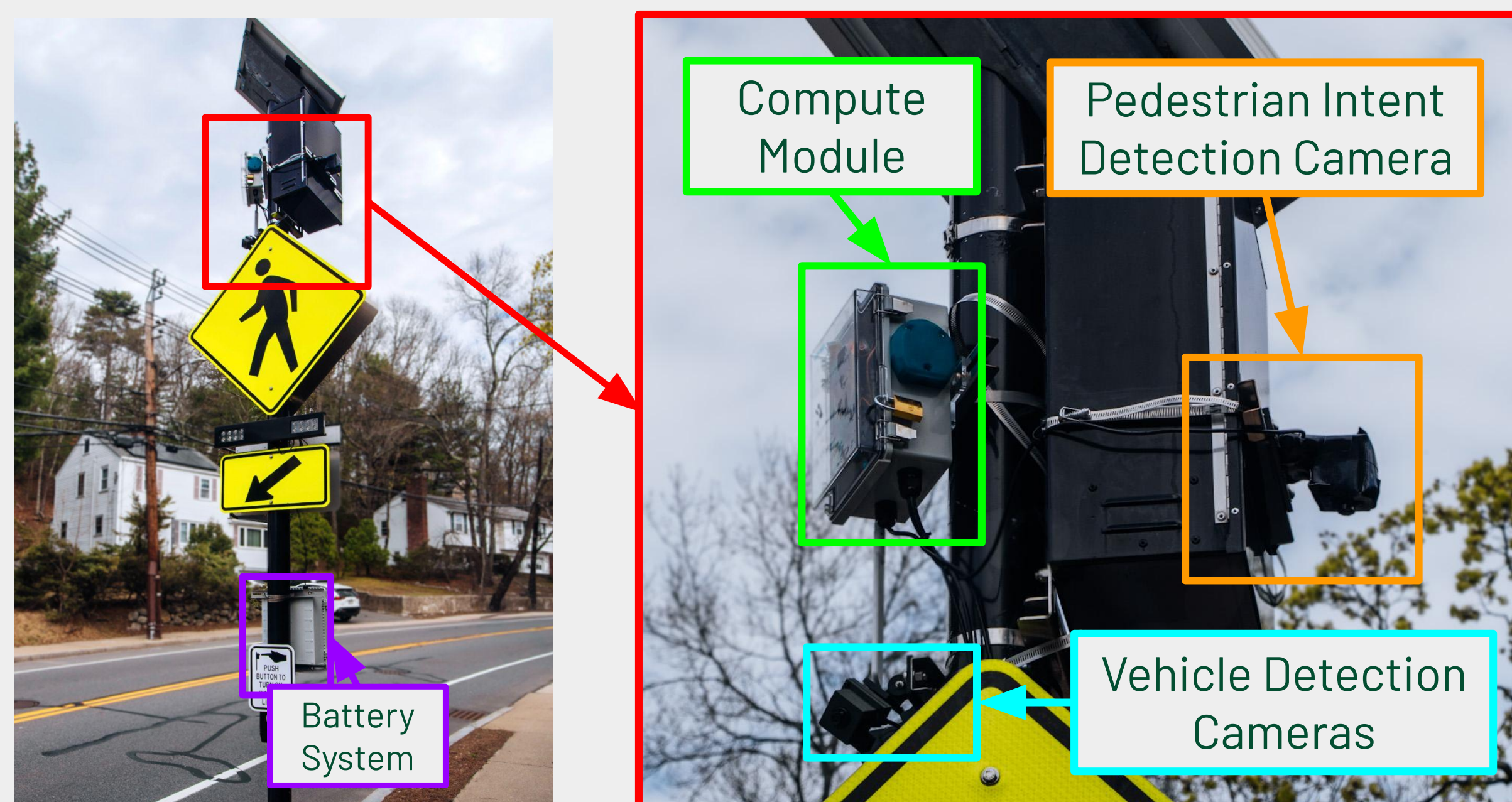
Project Objective: Develop a RRFB system that improves pedestrian safety through automatic detection, intent prediction, real-time activation, and data-driven insights.

Product Overview

The system has two main subsystems, designed to be discreet when integrated with existing RRFB hardware:

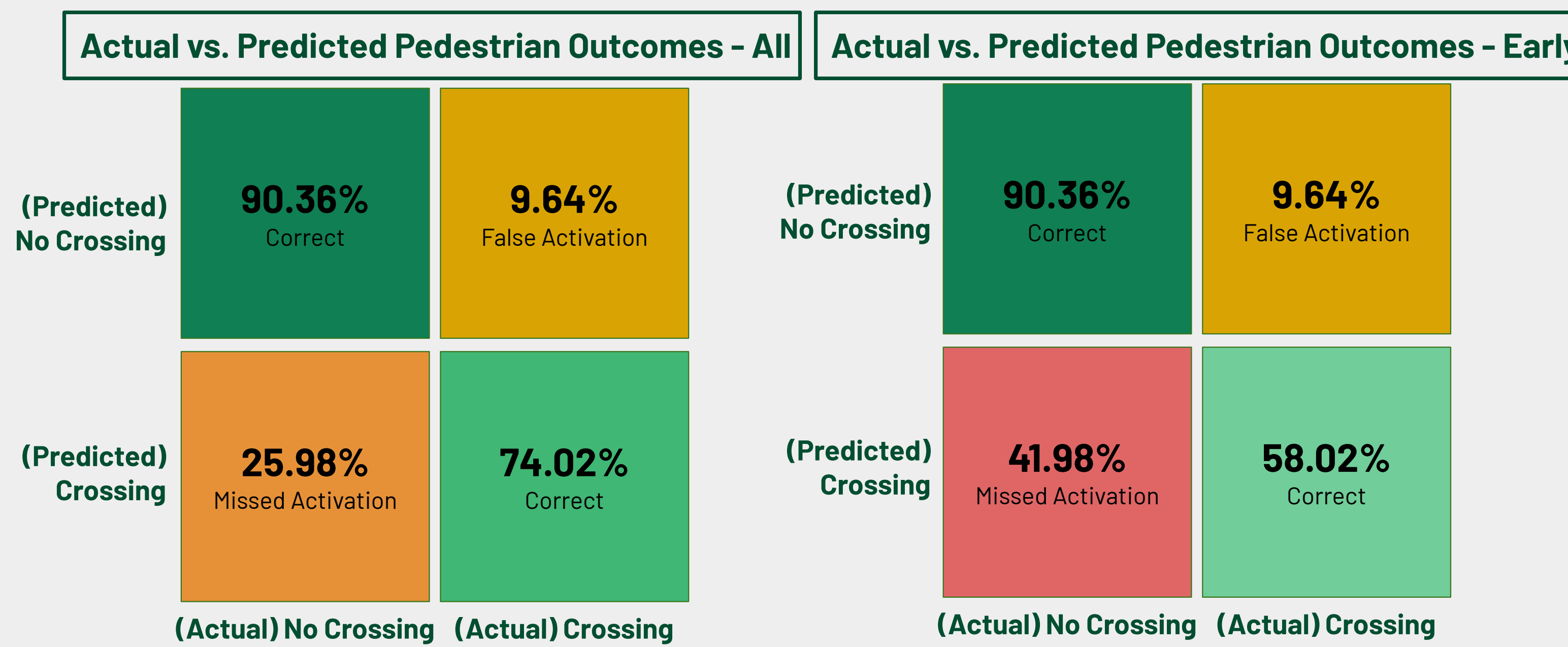
Pedestrian Path Prediction: A real-time overhead camera tracks pedestrian movement and predicts potential crosswalk entry 2–3 seconds in advance.

Vehicle Yield Analysis: Two pole-mounted cameras capture traffic in both directions and classify vehicles in post-process as yielding or non-yielding.



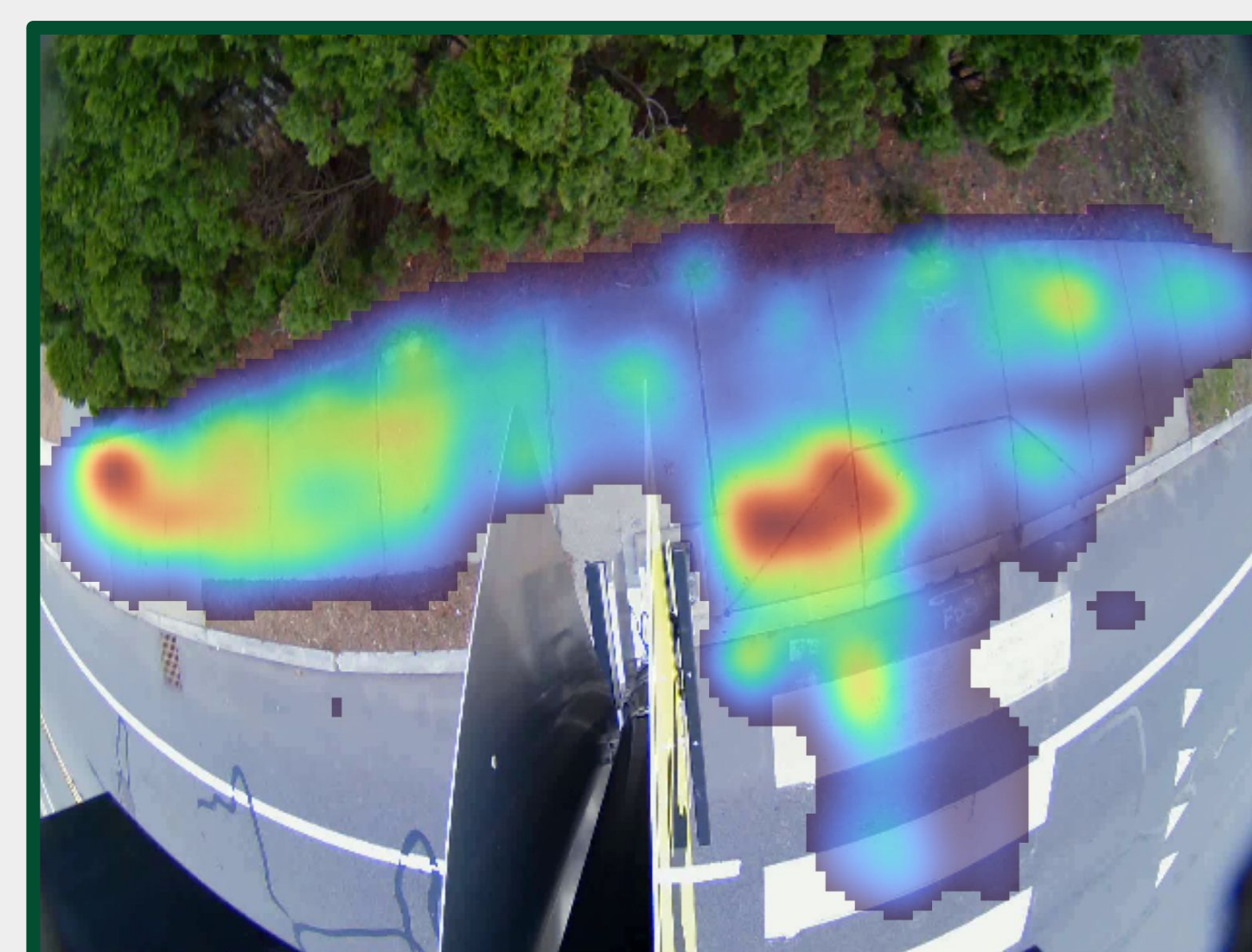
Test Deployment Results

The integrated prototype was deployed over two weeks in the Town of Needham. The system passively collected data to validate system performance.

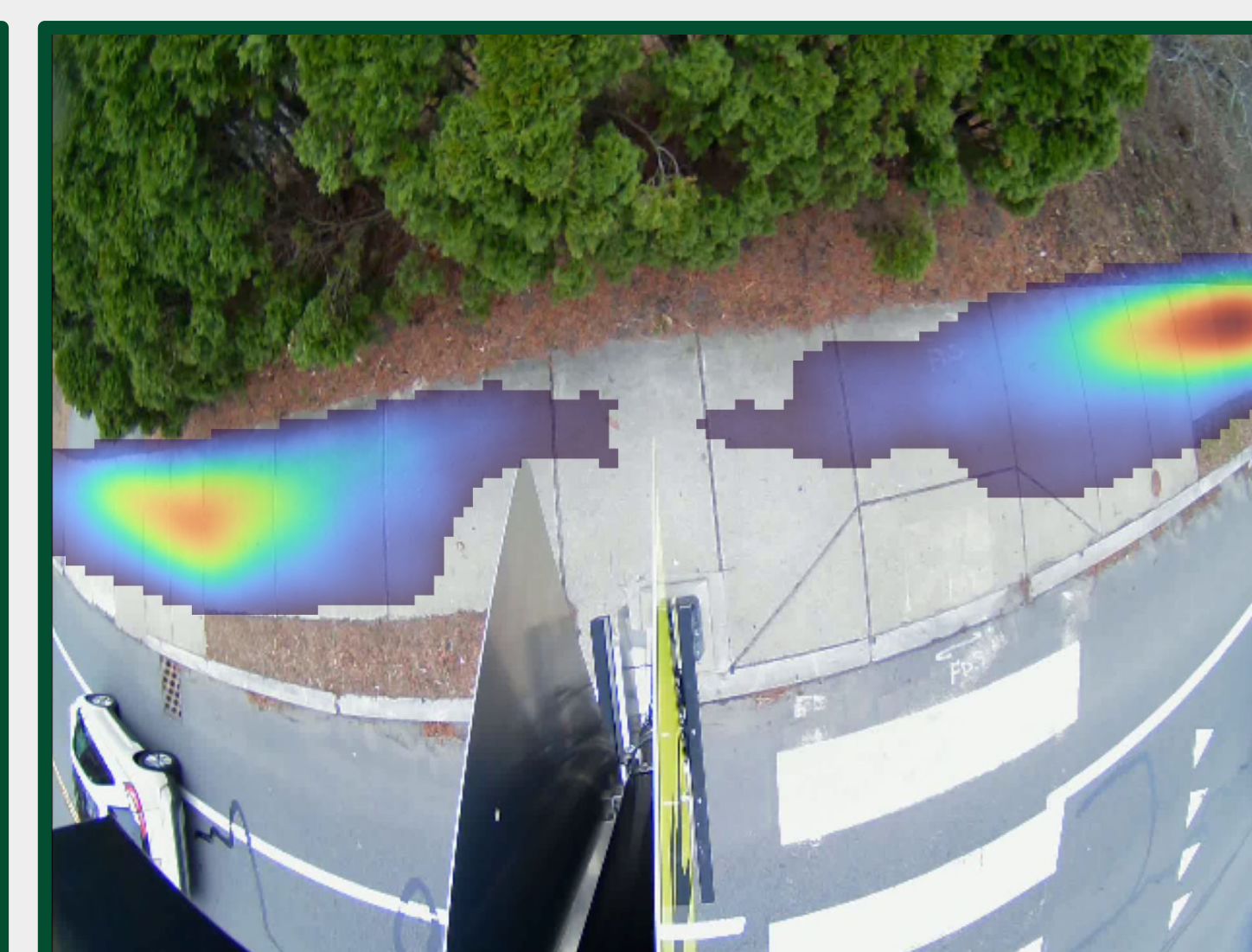


Figures 1a (left) and 1b (right): Pedestrian prediction accuracy metrics, all (1a) vs. early predictions (1b).

Pedestrian Crossing Heatmap



Pedestrian Not Crossing Heatmap



Figures 2a (left) and 2b (right): Heatmaps of pedestrian paths when crossing (2a) vs. not crossing (2b).

Vehicles Detected in Approach Zone by Hour (Full Deployment)

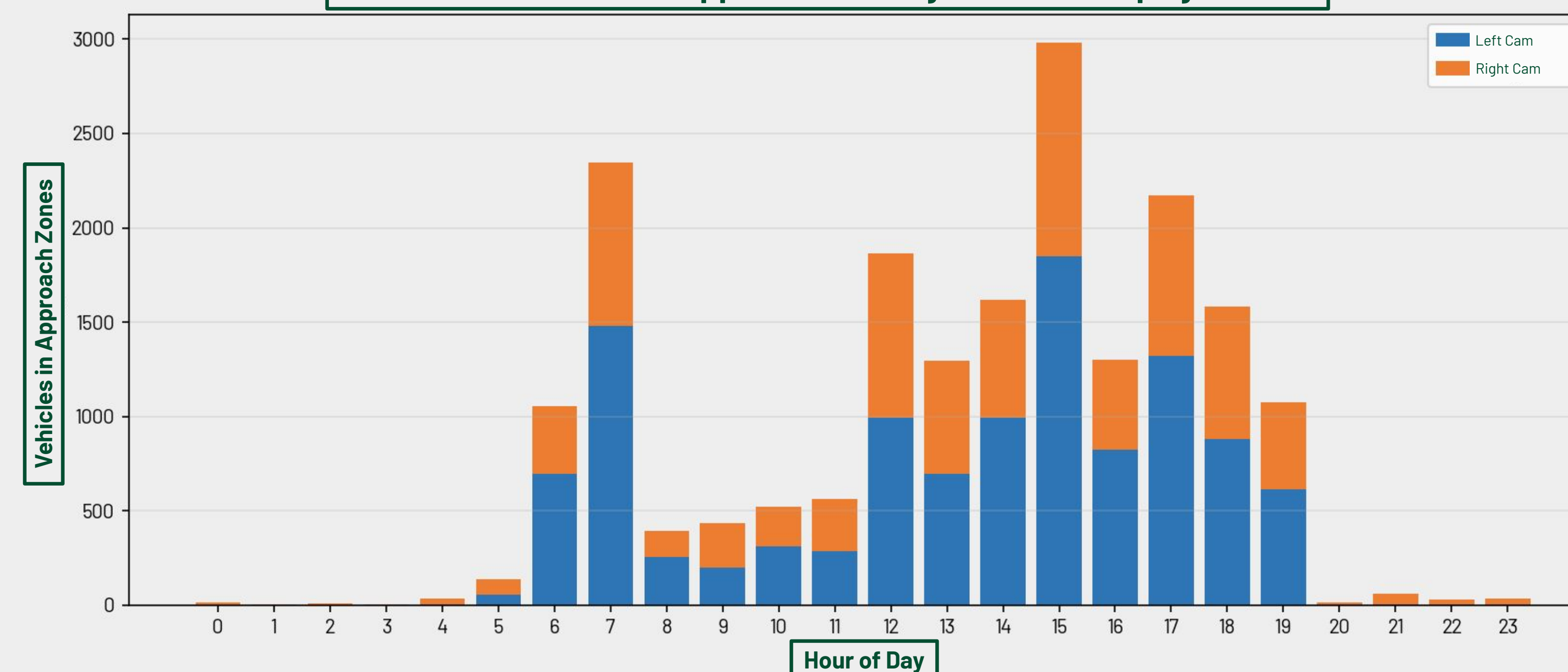


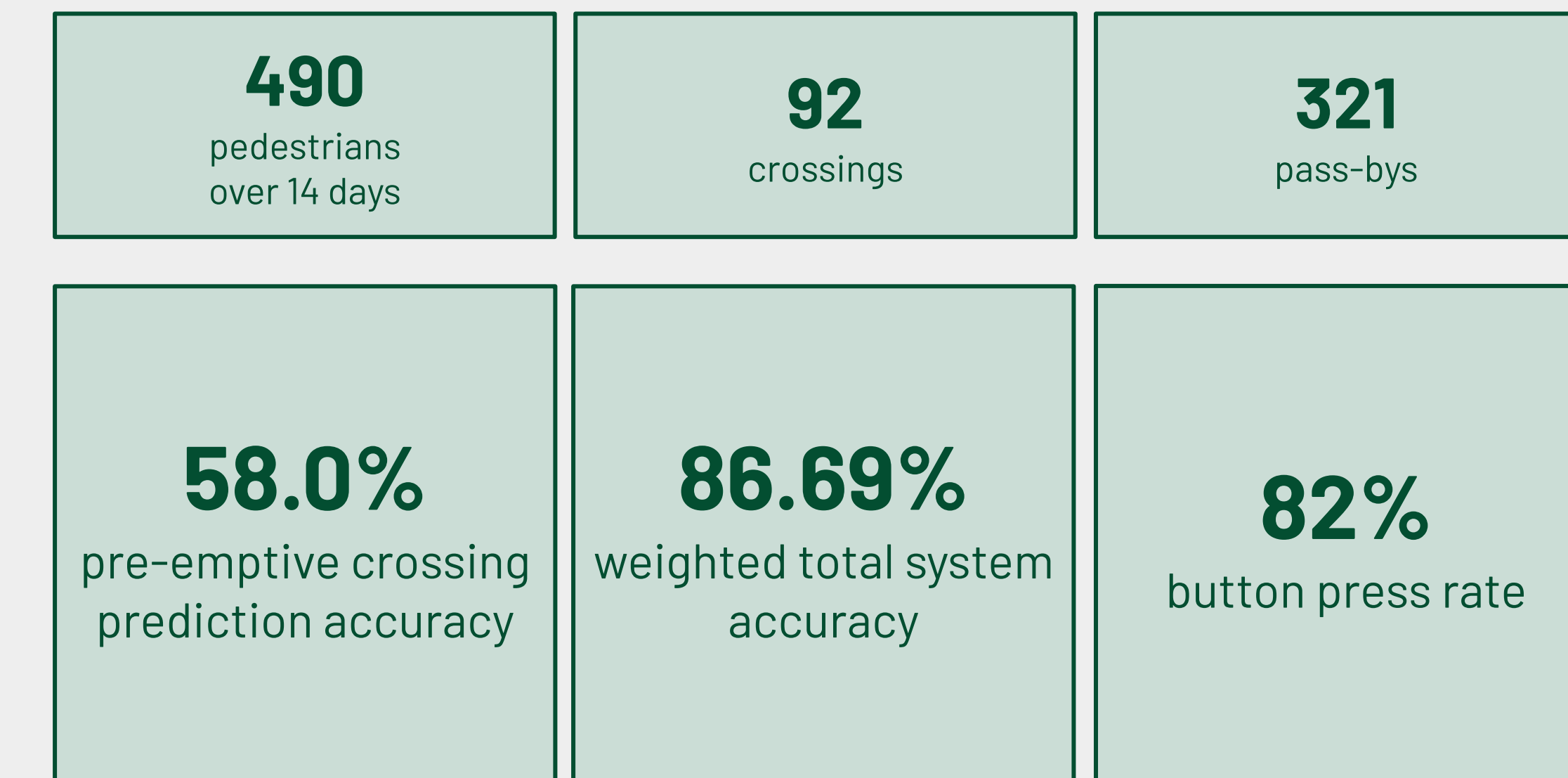
Figure 3: Chart of vehicle appearances across left and right cameras in a 24 hour period.

Limitations

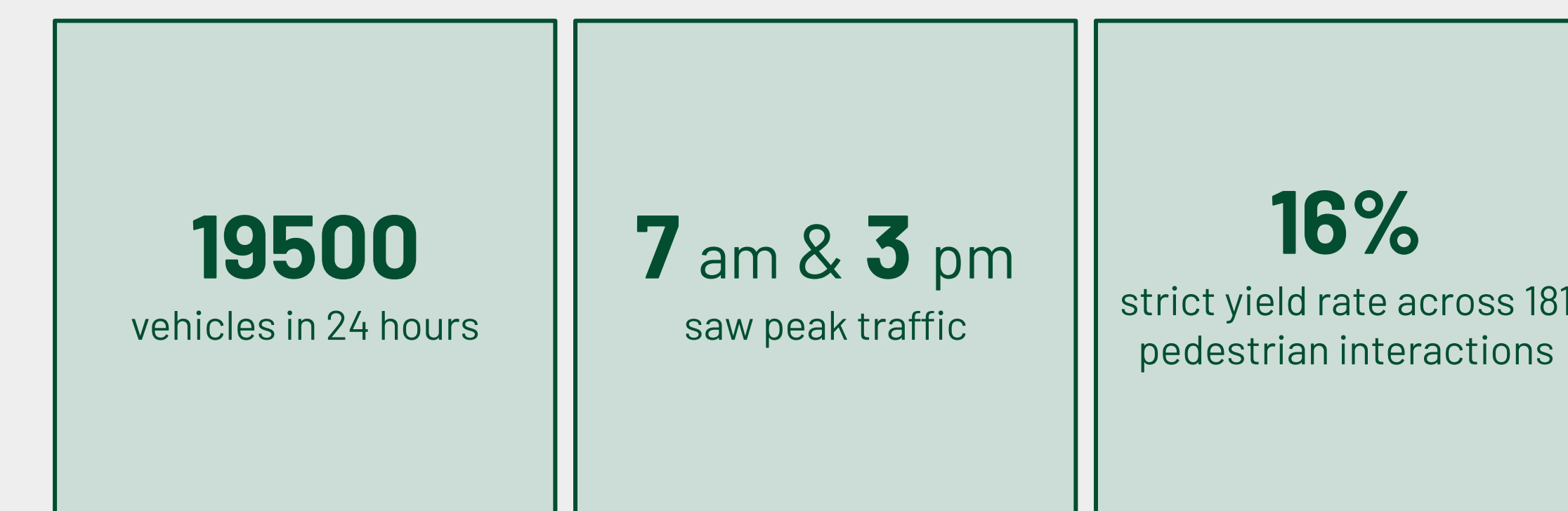
- A majority of missed predictions resulted from predictions made too early or too late, though the number of predictions are limited by computational constraints.
- Vehicles exhibit yield behaviors ranging from early full stops to close-up rolling stops, and the system will need more granularity in classification.
- Pedestrians who loiter, wait, or walk parallel to the curb can resemble crossing intent, leading to false positives, especially on narrow crosswalks like this one.

Key Findings

Pedestrian Detection



Vehicle Detection



Future Steps

- Transition proof-of-concept into a deployable, manufacturable system.
- Improve model accuracy through expanded testing and a larger custom-trained dataset.
- Upgrade system hardware, including dual-sided units, RRFB relay integration, and transition to grid power.
- Conduct human factors research to refine user interaction and stakeholder priorities.

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